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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

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Contents

	PAGE
Reclamation of Cast-Iron Borings	433
The Transverse Test	433
Correspondence	434
Model Blast Furnace	434
Random Shots	434
New Industries for Jarrow	435
The Use of Cast-Iron Borings	437
Foundrymen's Golf Competition at Matlock	438
Controlled Foundry Sand	439
All-Welded Foundry Extension	440
Revival of Basic-Bessemer Process in Poland	440
Notes from the Branches	440
New Companies	440
White Cast Iron	441
The New Factories Act—VI	443
The Vitreous Enamelling Section—	
Transfers Suitable for Vitreous Enamelling and their Application	444
Moulding and Preparation of Castings for Enamelling	445
Relation of Microstructure to the Enamelling Properties of Cast Iron	446
American Notes	448
Iron and Steel Output	448
The Week's News in Brief	450
Trade Talk	450
Light Castings Industry Adopts Holidays with Pay	450
Forthcoming Events	450
Raw Material Markets	452

Reclamation of Cast-Iron Borings

If Italy produces each year 45,000 tons of cast-iron borings—a figure revealed by Mr. Alfredo Palmucci in a Paper, a translation of which appears elsewhere in this issue—then the United Kingdom must have a minimum annual output of something of the order of 100,000 tons, though we confess that the figure is difficult to estimate. It is a matter for speculation what becomes of these borings, for, to our knowledge, they are disposed of by very widely divergent processes. The most extravagant method is their use as a paving material, and but little thought is required to evolve a better means for their re-entry into the metallurgical field. Next, there is their use as a raw material for the blast furnace, and it is not far from the truth to say that by the time they are absorbed in this manner they are well on their way to having reverted to iron ore. Finally, some borings are briquetted, or packed in sheet-steel or wooden containers for remelting. In connection with the last process, a good deal of intelligence is often shown in the mechanical and metallurgical handling. We cannot but feel that the outstanding feature which is so often forgotten is the time element, because with borings, presenting as they do an exceedingly high ratio of surface to weight, rapid deterioration sets in and this is largely responsible for the consequent heavy melting losses, so often ascribed to mechanical lightness—a factor of obvious importance.

Briquetting is a sensible method of rehabilitating borings, but it is difficult, and in most cases impossible, to establish an economic relationship between initial cost of plant, its potential output and available material. Only the very largest engineering works can strike a workable balance but by co-operation the scrap merchants could, in some districts, keep such a plant well engaged throughout the year. Care would have to be taken to keep the borings clean and fresh, and to briquette them reasonably quickly.

The suggestion made by Mr. Palmucci that in many cases one charge made daily in an already-hot cupola would absorb the normal output of many works and would prove adequate for the making of unimportant castings, or at the worst a few hundredweights of pig-iron, is worth consideration. When canisters are used, the borings can be, and very often are, used as a small proportion of every charge put through the cupola, and where a modicum of soda ash is incorporated in the canister, an ameliorative rather than an adverse effect is produced. It is usually accepted that if loose borings be charged there is a heavy loss through their becoming mechanically entangled in the supernatant slag. If this be the case, it would seem worth while to experiment with a cupola possessing in its hearth a centrally-disposed tap hole, which effectually prevents the existence of supernatant slag. To our mind, insufficient thought has been given to the reclamation of turnings and borings, and the problem is becoming more insistent as much of these now contain valuable elements such as nickel, molybdenum and chromium.

The Transverse Test

In view of the consideration now being given to the possibility of establishing international standard methods of testing cast iron, particular interest centres on the Paper by MacKenzie and Donoho recently presented before the American Society for Testing Materials* entitled "A Study of the Effect of Span on the Transverse Test Results for Cast Iron." In effect, this Paper—which, judging by the discussion, received world-wide attention—raises the question "when is the transverse test a tranverse test, and when is it something else, such as a shear test?" The Paper emphasises that the ratio of span to depth of test-piece must be greater than a limiting figure—generally 10—if the shear factor in the test is not to assume such proportions as to render it erronious as a transverse test. Actually a ratio of 20 seems nearer the mark. It is interesting, incidentally, to note that the 1.2-in. bar tested on 18-in. centres, standard in this country and in the U.S.A., gives a ratio of 15, whilst the German test on a 30-mm. bar at 600-mm. centres fits in exactly with the suggested figure of 20. The Paper gives detailed attention not only to the transverse modulus of rupture as determined by the test, but also to that factor variously called the "modulus of elasticity" or the "stiffness factor" which is derived from the deflection of the test-bar under load. The most important conclusions drawn from a study of available data and from the experimental work carried out by the authors are: (1) that the modulus of rupture increases with decreasing span; (2) that the decrease of deflection with decreasing span is less than would be expected from the conventional beam formula; (3) that the modulus of elasticity decreases with decreasing span, and (4) that the amount of the effect of changing span depends largely on the grade of iron under test. The work is undoubtedly a valuable contribution to our knowledge of the properties and testing of cast iron.

* A.S.T.M. Proceedings, Vol. 37, Part II. 1937, p. 71.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Is the "Boil" Important?

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—After reading the article on carbon and alloy steel castings by J. E. Mercer and D. K. Barclay (issue dated May 19, 1938, page 405), I beg to differ on one of the most essential points in the manufacture of carbon steel in the electric furnace, *i.e.*, "Is the boil important?"

From personal experience, the "boil" is necessary in the manufacture of steel from all processes where refining has to be done; also, the amount of rust adhering to scrap would not be sufficient to render the three main reactions, *i.e.*, elimination of silicon, carbon and phosphorus complete without the addition of extra oxide in the form of ore or mill scale.

Any authority with a working knowledge of the various steel-melting plants looks forward to the "boil" in order to drive heat into the charge, apart from the chemical changes set up. The same applies to the electric furnace, the "boil" enabling the charge to absorb the heat in the same way; also, any excessive heat which the refractories may have taken up will be absorbed by the boil, hence longer life to roof and linings.

I am producing steel in a 3-ton electric arc furnace, with the following analysis: Carbon, 0.20; silicon, 0.25 to 0.30; phosphorus, 0.015, and sulphur, 0.014 per cent., the time taken being 2 hrs. from current on, thanks to the "boil." The charge consists of 50 per cent. shop scrap and 50 per cent. bought-in scrap.—Yours, etc.,

DAVID W. EVANS
(Metallurgist, Steel Foundry).

Babcock & Wilcox, Limited, Renfrew, near Glasgow.

Publications Received

Aluminium Facts and Figures. Published by the British Aluminium Company, Limited, Adelaide House, King William Street, London, E.C.4.

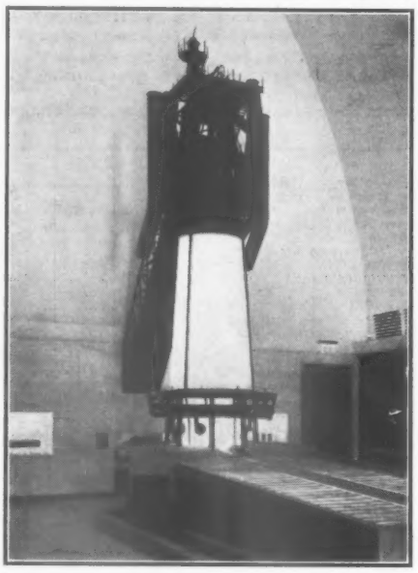
It is well recognised in foundry circles that the technical service given by the British Aluminium Company is of outstanding merit, yet it is doubtful if any effort made is more appreciated than this book under review, which must have run to several editions. It is of the pocket-book variety and contains about 190 pages. In it the practical man finds just those data he so frequently needs. There are the fundamental physical properties, formulæ, and all the better-known and widely-used standard specifications. The hints on mixing, melting and casting are authentic and reliable, whilst all after-treatment—machining, welding, heat-treatment or anodising—is admirably covered. It is indeed a full text-book on the subject but minus frills and packing! It is available to our readers on request to the British Aluminium Company.

Analysis of British (United Kingdom) 1937 Exports. Published by the "British Engineers' Export Journal," Dorset House, Stamford Street, London, S.E.1. Price 10s. 6d., post free.

This comprehensive survey of United Kingdom engineering exports to the principal countries of the world includes engineering exports to 112 countries, which are tabulated under about 80 headings. Manufacturers and exporters will find it an exhaustive and reliable guide to the many categories of engineering exports upon which to base their plans for future development. It is produced in handy folder form.

Model Blast Furnace

The main feature of the Iron and Steel Hall at the Empire Exhibition is a model blast furnace, with a pig bed and hot-metal and slag ladles to a scale of one-sixth full size. The model is based on a modern mechanically-charged furnace, with double-skip hoist and a hearth diameter of about 16 ft. The stack, bosh and hearth are made of glass, lighted from inside by means of discharge tubes arranged to give a gradation in colour from dull red at the top to white at the bottom. The stack section is etched to represent plate construction. The skips are arranged to travel up and down on the incline. The height of the furnace is about 26 ft. to the top of the torches. On each side of the pig bed is a railway track, on one of which stands a model of a 75-ton hot-metal ladle and on the other a 20-ton compressed-air tipping-type stack ladle. The pig bed and ladles are arranged to appear as though casting is just being completed. For this purpose the iron and slag in the runners, on the bed and in the ladles, are represented by glass plates illuminated from below.



MODEL BLAST FURNACE IN THE IRON AND STEEL HALL AT THE EMPIRE EXHIBITION.

Book Review

Factories Act, 1937—Comparative Statement. Published by the National Confederation of Employers' Organisations, Millbank House, 2, Wood Street, Westminster, London, S.W.1. Price (post free): Paper bound, 2s. 9d.; cloth bound, 4s.

The new Factories Act, which was passed last year and which introduces many important and far-reaching changes affecting all occupiers of factories, will come into operation on July 1 this year. In order that employers in the various industries may have the position clearly and fully before them, the Confederation—which is the central employers' organisation for dealing with general labour questions—has prepared this handbook for their guidance. The characteristic feature of the handbook is that it sets out every requirement of the Act in clear and simple language and contrasts these requirements with the corresponding provisions of the existing law. The handbook extends to 200 pages and includes an alphabetical index of 30 pages.

Random Shots

Everyone is looking forward to this week-end, with its opportunity for extended recreation. Some will bend a willing back over tender seedlings in the garden. Others will do as George Formby and the Government tell them and Keep Fit by various pleasant means; by golfing, by walking or by cycling. But if the rain continues to come down as it did last week-end (and who dare say it nay?), the libraries look like doing as brisk a trade as the cinemas. For those who do not keep a library list a yard long, here are a few suggestions for some interesting reading over the holiday.

* * *

To begin with, Blackwoods Magazine for May has an excellent contribution entitled "Not Enough Cooks," which will at once elicit the understanding and sympathy of anyone who has to do with works management. It is a story in which the author endeavours to show how the "Epoch-Making Event" of a great merger is not always an occasion for marvelling, but more often spells failure. He draws an accurate picture of the muddles and incompetencies in a large steelworks (originally built up by the sheer hard work of one clear-headed ambitious man), which somehow rings exceptionally true. The downfall started when the father retired and his sons took command. The author finally sums up his indictment with the truism that the failure was caused not so much by there being not enough cooks, but that "there was not a decent cook amongst the whole damn lot."

* * *

Another picture of the inside life in a steelworks, this time written from the worker's point of view, is portrayed in one of the contributions in "Seven Shifts." This book is an attempt to find out what the worker thinks about his job, and each section is written by a man engaged in the trade. Of the seven different trades represented, two at least should make interesting reading for foundrymen—"The Steel Works," by James Stirling, and "A Blast Furnace Worker," by J. H. Watson.

* * *

The latter writer revives a story which had its own bitter application in many works during the bad trade period, and at which happily most people can afford to laugh nowadays. The forewoman was showing the manager round the canteen.

"You keep cats here?" he asked.

"We really need them for the mice, you know," the girl explained.

"Yes. Well, put them on week about!"

* * *

Another fascinating book with a wider interest is to be found in "London in 1710," being extracts from the travels of Zacharias Conrad von Uffenbach, translated from the German by W. H. Quarrel and Margaret Mare. In it the author is constantly complaining of the way the interiors of London houses and public buildings are utterly ruined by grime and coal smoke. He describes a visit to one Perigo who had invented a method of gilding steel with mercury so that it does not tarnish. He passes some caustic comments upon the conduct of the Royal Society, as it was then. When he asked after anything, "the operator who shows strangers round" usually remarked that "A Rogue had it stolen away," or that "It is corrupted and broken." And this he deplores, because "both in Germany and elsewhere an exalted idea of this Society had been formed." There is mention of a Swede called "Boer in St. James Street," who was, according to the author, the most famous enameller in England, and who was at that time working on a handsome plaque of the battle of Höchstätt.

"MARKSMAN."

New Industries for Jarrow

STEEL FOUNDRY AND TUBE WORKS OPENED

Jarrow Metal Industries and Jarrow Tube Works, established at Jarrow through the efforts of Sir John Jarvis, M.P., were formally opened last Friday. The works have actually been in operation some weeks. The tube works, which employ 200 men, are situated in what was Palmers' shell shop, and the metal works, employing 150, in what was the boiler shop. The tube works were opened by the Duchess of Northumberland and the metal works by Lady Jarvis.

A luncheon, over which Sir John Jarvis presided, held at Newcastle preceding the opening ceremonies, was attended by 150 guests, including many business men and civic representatives. These included:—The Duchess of Northumberland; Deputy Mayor of Jarrow (Ald. T. O'Connor); Miss Ellen Wilkinson, M.P. for Jarrow; Mr. C. S. Perkins, Town Clerk; Bishop of Durham, Right Rev. J. G. Gordon; Sir Nicholas Gratton Doyle, M.P. for Newcastle North; Mr. T. Magnay, M.P. for Gateshead; Col. J. A. C. Younger, of Guildford; Major T. G. Bird; Mr. W. Scott; Col. K. C. Appleyard and Dr. Kurt Gruber.

At the luncheon, SIR JOHN JARVIS read a telegram from the King and Queen wishing success to the new works. The DEPUTY MAYOR OF JARROW (Ald. T. O'Connor) proposed the health of Sir John. Replying, SIR JOHN said he believed they had won through in their efforts to help Jarrow. He was optimistic about the future of the works. They would be engaged in production both for home and foreign markets. At present not more than 10 per cent. of the work in hand was in connection with the Government's defence plans. When he came to Jarrow four years ago, 80 per cent. of the people were unemployed, but to-day there were 30 per cent. Of the 2,322 unemployed, he reckoned that one-third would be unemployable in heavy industries, which left only 1,500 for whom to find work. The position was improving every day. He referred to the Jarrow Steelworks plan, and said this was only a fraction of the original scheme defeated two years ago. He announced that he had secured Palmers Dock and 17 acres of land adjoining for the purpose of continuing the Jarrow shipbreaking industry.

The directors of Jarrow Metal Industries, Limited, and Jarrow Tube Works, Limited, deserve congratulation upon their enterprise and perhaps also upon their foresight. There is a shortage of steel foundries on the North-East Coast, and as the foundry of Jarrow Metals, Limited, is capable of producing steel castings of any alloy up to 10 tons in weight, it will add very materially to the industrial strength of the district. There was also a real need of a works capable of economically producing solid-drawn tubes of good quality and capable also of meeting the demands for tubes of the highest quality. Although the works in question have only recently been put on production, the influx of orders and the substantial inquiries provide a happy augury for the future success of the undertakings.

The directorate of Jarrow Metal Industries, Limited, consists of Sir John Jarvis, Bt., D.C.L., D.L., M.P. (hon. chairman), Major T. G. Bird, D.S.O. (vice-chairman) and Mr. William Scott. They occupy similar positions on the board of the Jarrow Tube Works, Limited, Mr. William Scott being managing director. The

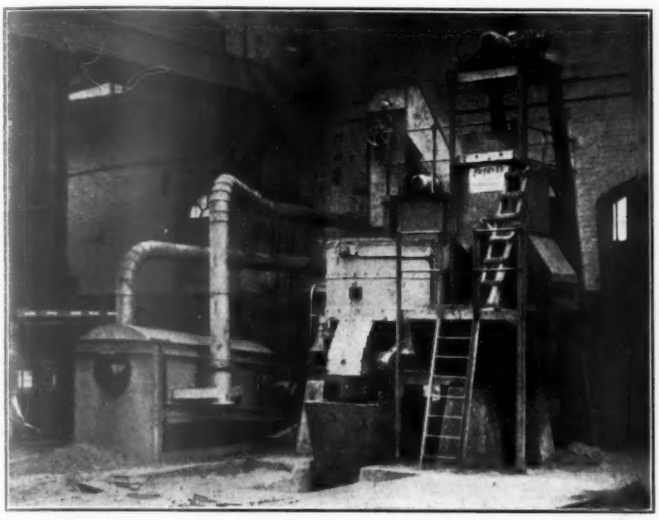


FIG. 1.—COMPOSITE SAND-MIXING PLANT.

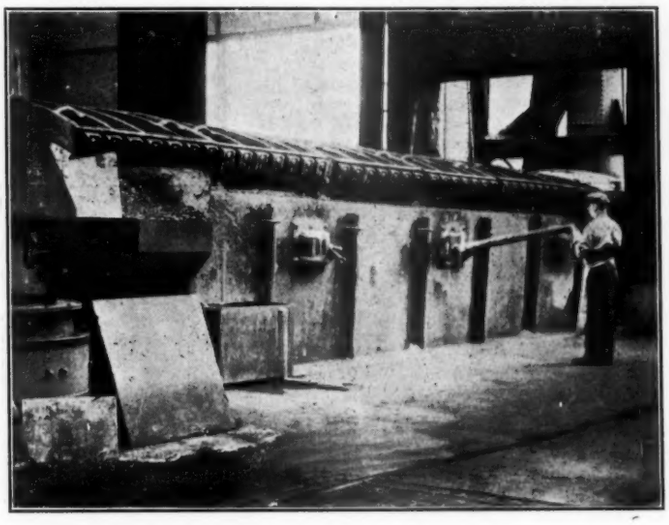


FIG. 2.—MELTING FURNACE FIRED WITH PULVERISED FUEL.
JARROW METAL INDUSTRIES, LIMITED.

FIG. 3.—GAS-FIRED ANNEALING FURNACES.
JARROW METAL INDUSTRIES, LIMITED.

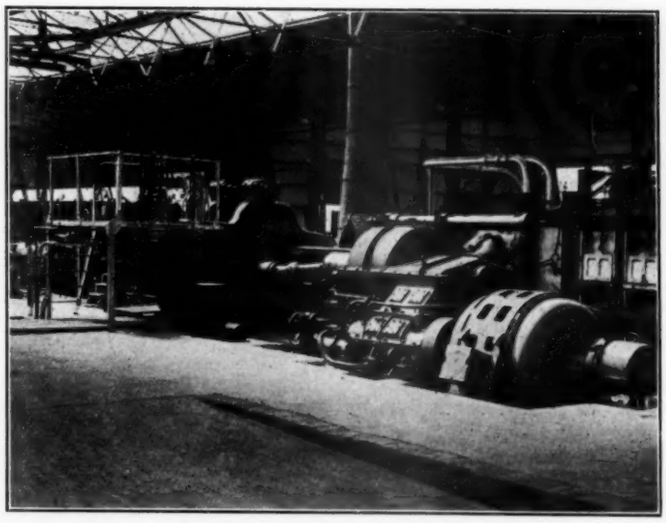


FIG. 4.—PIERCING MILL AND 720-H.P. ELECTRIC DRIVE.
JARROW TUBE WORKS, LIMITED.

other directors are Mr. Benjamin Price (consulting engineer) and Mr. Francis Williams. The two works are, however, run by entirely independent companies, whilst both are associated with Armstrong Whitworth & Company, Limited.

Both works occupy a portion of the site of the Palmers Works. The offices of Jarrow Metal Industries, Limited, front on to Western Road, whilst the tube works are about ¾ mile to the rear. Both works are bounded by the lines of the L. & N.E. Railway and connected thereto by sidings, whilst intercommunication between the two works is by private line.

JARROW METAL INDUSTRIES, LIMITED

The works of Jarrow Metal Industries, Limited, have been laid down as a foundry for the production of light and heavy (up to 10 tons) steel castings, for the casting of billets for the tube works and for the manufacture of special alloy rolls. One portion of the foundry is laid off for the production of refined iron, which is supplied to the trade in the form of pigs; a large proportion of this production is, however, exported.

The works are contained in a building of four bays, with an additional stocking bay for the iron foundry. One of the side bays is laid off for stocking, cleaning and inspection. This bay is served by two 30-ton cranes. The second of the side bays is given over to light castings and is served by three cranes of 10 tons, 15 tons and 8½ tons capacity respectively. The main bay in which the rolls and billets are cast and where also is installed the melting plant is served by a 100-ton crane and a 60-ton crane, each of these being fitted with a 15-ton auxiliary hoist.

At the end of the main bay the sand plant is installed. Generally a mixture of Belgian and Consett sand is employed. Mixing is done in an August No. 2 Intensive Mixer; this is complete with a dust-extraction plant, thus ensuring a uniform permeability in the moulding sand. For the time being a sand-blast plant, by the St. George's Engineering Company, in which air at 80 lbs. pressure is employed for blasting, is installed in the sand shop; this, however, is a temporary expedient, its ultimate position being in the casting bay proper. The core shop is housed in an annexe; oil sand is employed exclusively and all cores are hand made. The core shop has a coke-fired drying stove. There are three mould-drying stoves, coke-fired and served by bogies running on ball tracks. The drying stoves as also the core stove were supplied by Pneulec, Limited, of Smethwick.

The roll-casting pits have depths of 18 ft. and 10 ft. respectively, and they are served by a Babcock & Wilcox auxiliary overhead crane of 40 tons capacity. The pit for casting billets contains two stands each of 56 moulds, each stand being poured from one runner, the weight of metal being approximately 10 tons.

The Melting Plant

The melting plant comprises a 15-ton Tagliaferri electric furnace built by Metalectric Furnaces, Limited, of Smethwick. This was described in our issue for March 31 last. Reference, however, was not made to the method of charging, which comprises a steel-hopper basket with an outwardly-opening bottom, by means of which the furnace can be fully charged in 15 min. For the time being the furnace is only working two shifts, conditions which, of course, reflect unfavourably upon its performance, particularly in the matter of power consumption, although, considering the conditions, this is remarkably low, averaging between 650/750 kw.-hrs. per ton of saleable metal; the time for melting is 3 to 4 hrs., dependent upon the charge. In addition to the above, there is a Whiting air furnace of a melting capacity of 30 tons, fired with pulverised fuel. It will be appreciated that the electric and the air furnace form a combination which can produce a very wide range of analyses for rolls up to 40 tons.

Metal for the light-castings bay is teemed into ladles of varying capacities and placed by the melting-shop crane on the saddle of a transfer bogie, which is travelled into the light-castings bay and thence taken care of by one of the cranes in that bay. Rolls and billets are cast from bottom-pouring ladles which are handled by the melting-bay crane.

Heat-Treatment

With the use of complex alloy-steel mixtures for rolls, the heat-treatment becomes very exacting. For this purpose there is a Gibbons furnace 20 ft. by 10 ft. 6 in., and two Gibbons Davis pit furnaces of approximately the same size. These furnaces, which are fired with town's gas, are capable of controlled temperatures up to 1,100 deg. C. It may be interesting to note that the cycle of operations in heat-treating certain rolls occupies about ten days. After stripping, the billets are dressed by pneumatic tools and cut to lengths with a Noble & Lund sawing machine driven by a 10-h.p. motor. One billet out of each cast is sampled, and subjected to both physical and microscopic tests.

Refined Iron

The stocking bay for the plant making refined iron is spanned by a gantry 36 ft. wide and 600 ft. in length. The runway is travelled by a 15-ton magnet crane, whilst the stocking ground is intersected by two lines of railway track. The melting plant consists of a cupola of 16 tons per hr. melting capacity. It operates continuously feeding into a 15-ton receiver. The cupola is automatically charged, the charging boxes being of 30 cwts. capacity, and are of the bottom-discharge type. The magnet crane loads them up as they travel the ground on bogies, from which they are raised to charging level and discharged into the cupola by a mono-rail crane of 2½ tons capacity.

Blast is supplied by a motor-driven Keith Blackman fan capable of a duty of 9,000 cub. ft. per min. at 26 in. w.g. There are two pig beds, in parallel, fed through special runners from 12-ton ladles, the pigs being broken by hand hammer. The normal weight is 28 lbs., which is found the most convenient size to handle.

Power and Distribution

Power is taken from the North-East Coast supply at 20,000 volts, 3-phase, to three separate sub-stations. One serving the electric furnace is equipped with a B.T.-H. transformer which steps down the current to 200/81 volts. In the second sub-station a B.T.-H. rectifier converts the 20,000-volt current to 480 volts direct current for the shop cranes. The third sub-station, also equipped with B.T.-H. units, steps down the alternating current to 440 volts for the motors on the works, whilst a rectifier converts to 240 volts direct current for the magnets.

A motor of 12½ h.p. drives the hydraulic pump for the supply of power to the electric-furnace gear. The cupola fan is driven by a Greenwood & Batley motor of 72 h.p. An Alley & MacLellan compressor of 300 cub. ft. per min. at 80 lbs. is driven by an 80-h.p. motor. For the supply of air pressure for the shop work there is a 500 cub. ft. per min. compressor delivering at 100 lbs. pressure, driven by a motor of 110 h.p.

Naturally in a works of this nature the laboratory must play a very important part, and the laboratory at the works of Jarrow Metals, Limited, has been very generously equipped for the duties it is called upon to perform. The equipment includes electric furnaces with all possible accessories for the analysis of iron, steel and refractories, and, needless to say, all raw material as well as the finished products are carefully checked and recorded. On the physical side there is a machine for tensile, compression, bending and transverse testing, while Izod, Brinell and Firth Hardometer tests are also carried out. There is a well-served micro-photographic department with a Vickers projection microscope and all accessories.

FIG. 5.— BATTERY OF TWO PILGER MILLS WITH 540-H.P. ELECTRIC

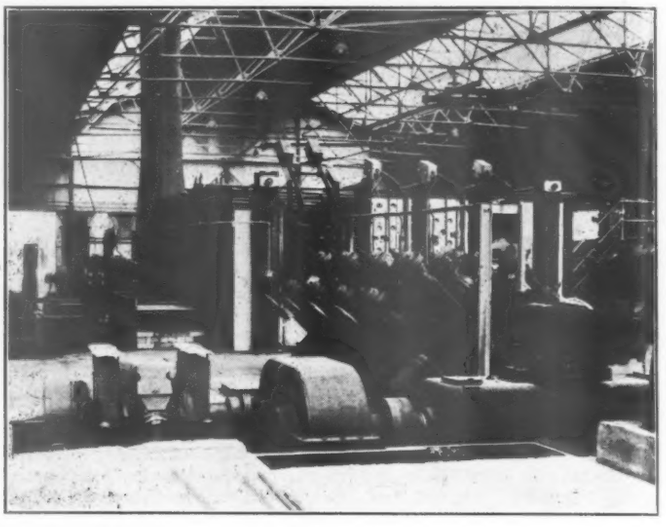


FIG. 6.—HOT REDUCING MILL WITH 135-H.P. ELECTRIC DRIVE. JARROW TUBE WORKS, LIMITED.

The Use of Cast-Iron Borings*

By A. PALMUCCI

The amount of cast-iron borings produced when castings are machined varies between 220 and 660 lbs. per metric ton of rough castings. Considering a yearly production of 380,000 metric tons of castings (Italy's production for 1937), and allowing for 15 per cent. of borings on 300,000 metric tons only,† an amount of 45,000 metric tons of borings will be obtained, which figure approximately agrees with the real quantity of borings produced in Italy in 1937. These cast-iron borings can be remelted by one of the following methods:—(*a*) Electric furnaces; (*b*) cupola, after briquetting; and (*c*) cupola, after filling the borings into metallic containers.

The first method meets the autarchy programme best; its ready application involves the following drawbacks:—

(1) An electric furnace plant is very expensive and its use cannot be very extensive.

(2) Cast iron can be melted to advantage by electric furnace only when the electric power cost is as low as 1 to 1½ farthings per kw.-hr., which price but few industries can secure except by contracts to take 500 to 1,000 kw., usually for night service.

(3) Should the use of the electric furnace become general, the electric power companies would not be able to meet the sudden power demand, which would become acute, especially in winter time. A considerable increase of lines would, moreover, become necessary, implying exceptional expenses, such as the use of copper, etc.

Although the electric furnace cannot be expected to be generally adopted in the course of the next few years, it is to be hoped that its use may gradually increase. It should be sufficient for the present to promote the installation of collecting centres for borings in all main industrial cities and of electric furnaces specially studied for the purpose, to operate in suitable areas. Melting could be carried out during the night. Reckoning the power consumption at 600 kw.-hrs. per metric ton of produced cast iron, at the price of Lire 0.12 (1.2 farthings) per kw.-hr. gives a power cost of Lire 72 (about 15s. 2d.) per metric ton of produced cast iron. Labour, plant upkeep and amortisation rates cannot be easily estimated as they depend upon many factors, chiefly upon the required daily output. The total average manufacturing cost can, however, be approximately estimated at Lire 200 (about £2 2s.) up to Lire 250 (about £2 13s.) per metric ton of remelted cast iron. This cost would allow one to pay a good price for the borings, and to induce all producers of the remelted iron to collect them with great care, which would benefit national economy.

Cupola Melting of Cast-Iron Borings

It should first of all be pointed out that the cupola-melting of cast-iron borings either as briquettes or packed in metallic containers requires a special control of the furnace in order to keep the metallic losses due to oxidation within reasonable limits. Even when melting a charge containing 15 to 20 per cent. of borings, the following troubles may be encountered in the molten metal if definite rules are not observed: (1) A noteworthy increase of gas-absorption in metal during melting process; (2) a considerable reduction in T.C, Si and Mn contents; (3) unusually large amount of slag, and (4) oxidised, sluggish metal and defective castings.

To avoid these troubles, briquettes or containers ought to reach the melting zone when still intact and to remain there as short a time as possible. It should be pointed out that the small briquettes (about 3 kg., *i.e.*, 6½ lbs.) highly compressed, free from non-conducting binders, have given the best results. The thermal conductivity of the briquettes is considerably reduced when the metal lump is made discontinuous by small air chambers. This point as to the use of binders is also a cause of troubles, although of much less consequence; if the percentage of binders is restricted to 10 to 12 per cent., it does not notably lessen the thermal conductivity of the briquettes. This is also true for the borings if they be compressed in metallic containers. These should have a maximum capacity of about 4 quarts; the best range between two and three quarts. The borings should be compressed at the maximum pressure the containers can withstand; the contents should in any case have a density of about 2.5. Either the briquettes or the containers, as the case may be, should be charged in the central zone of the furnace on top of their appropriate charges and beneath the coke of the next charge.

The pressure and the air volume should both be reduced in accordance with the percentage of borings added to the charge. The height of the melting zone above the tuyeres should be higher than normal.

Briquetting Plant

The choice of a suitable briquetting plant will depend upon the amount of borings to be daily briquetted. A large plant can briquette 100 metric tons of borings per day. In Italy, however, such plant could only be used in a borings-collecting centre, and two plants of this kind would be sufficient for the whole production of the country. Small plants for the production of about 1 ton of briquettes per day could be extensively used. In accordance with the good results achieved in some plants installed in other countries, a 300-ton press should be used so as to compress the briquettes of 100 mm. (4 in.) diameter at a pressure of about 4 metric tons per square centimetre (about 25 tons per sq. in.) required to give the briquettes a suitable thermal conductivity and adequate toughness.

In some large foreign plants, the briquetting costs including labour, plant upkeep, amortisation, etc., amount to about 8s. 5d. per ton of manufactured briquettes. In a small plant of 1 ton daily output, the total cost should not be above 14s. 9d. per metric ton. These plants are at present studied by some manufacturers of hydraulic presses. The idea is good and deserves attention. The cost of £530 for a plant of this kind, including pump, accumulator, charging hopper and cost of installation, would be reasonable; with an output of 250 tons per year, the whole cost of the plant should be saved in two years.

Melting of Cast-Iron Borings in Canisters

This method of making use of borings is very widely practised and has been universally successful. With the object of studying it systematically, tests have been carried on for about six months during which the different factors were modified one at a time, taking care to maintain the other factors as constant as possible. The following variables were examined:—(1) Volume of canisters; (2) density of borings after compression; (3) volume of air entering the furnace per minute; (4) air-pressure in the wind box; (5) amount of borings in the charge; (6) coke ratio, and (7) height of melting zone above tuyeres.

The following results were sought:—Minimum total loss, minimum loss from the oxidation of the C, Si, Mn, and the production of clean fluid metal free of gas.

It is obvious that the best way to carry out systematic tests and to draw conclusions from them was to use charges of 100 per cent. of borings of established average composition. It was the only way to find out the total loss and the loss from oxidation of the different elements during the various stages of the melting process.

For the sake of brevity, instead of detailing the various results obtained as tables, only the data will be given which gave promise of giving the best performance in a cupola of 26 in. dia. using charges of 100 per cent. cast iron borings: Height of melting zone above tuyeres, 56 in.; weight of charges (all borings), 220 lbs.; weight of coke, 44 lbs.; air volume, 777 cub. ft. per min.; weight of flux (limestone) used, 11 lbs.; capacity of canisters, 4 quarts; weight of canisters, including borings, 22 lbs.

The following should be noted:—(*a*) The coke percentage; (*b*) the small charge exactly half the standard melting charge; and (*c*) the low pressure and the small air volume. The above figures combined to produce the following results:—

	Average analysis of borings.	Analysis of test-pieces at beginning of melting process.	Analysis of test-pieces at end of melting process.
T. C, per cent.	3.3	2.9–3.00	2.5–2.8
Si, per cent.	2.8	2.0–2.20	1.6–1.8
Mn, per cent.	1.1	0.60–0.80	0.50–0.70
S, per cent...	—	— 0.10	— 0.10
P, per cent...	—	— 0.12	— 0.12

The total melting loss accurately calculated on 20 consecutive melts varied between a minimum of 6.7 per cent. and a maximum of 9.8 per cent. The following melting practice was adopted. At the end of a normal day's run, as soon as the whole of the metal was run from the spout, the blast was shut off and the coke bed was raised up to 56 in. The furnace being charged right up to the charging door, the blast was put on at reduced pressure of about 8 in. water gauge. The first metal at the spout was fluid and clean and could be used for common castings. Should a particularly soft cast iron be required, a suitable amount of ferro-silicon is added to the 100 per cent. borings charge. A test-specimen is taken from each ladle, and, when the iron appears to be on the hard side, suitable castings (such as grates, counterweights, common iron fittings, etc.) are poured, or the metal is pigged. With still harder iron, the metal is pigged. Each ladle is desulphurised with soda ash, and the amount of borings melted should never exceed three tons, because in the later stages slag formation is heavy.

The melting of a 100 per cent. borings charge after a normal day's work can be very advantageous for such foundries, which, being engaged in making very large castings, cannot afford to take the slightest risk of producing faulty work. These foundries should use the borings for casting suitably-sized pig. This pig can be easily classified in three groups, according to fracture (normal, semi-hard and hard), and the amount which can be used may be of the order of 10 to 40 per cent. of the total charge. When no other means are available to obtain close-grained castings of considerable tensile strength, this pig is very useful, and the production of faulty castings need not be feared.

Other foundries prefer to add 15 to 20 per cent. of cast-iron borings to the normal everyday charge. In such instances, it is difficult to find out the loss to be imputed to the amount of added borings, and consequently to state whether the furnace control is adequate. It may happen that 30 to 40 per cent. of the added borings go to waste, and that no notice is taken. If, however, the furnace is properly controlled and the above rules are observed, the use of 15 to 20 per cent. borings in the charges will not cause any trouble.

(*Continued on page* 438.)

* Translation of Paper, presented to the Milan Meeting of Italian Foundrymen, from "L'Industria Meccanica."

† As a portion of the produced castings carries very little or no machining at all.

Foundrymen's Golf Competition at Matlock

Few golf courses in this country can use less sand than the course at Matlock, where the Institute of British Foundrymen last Sunday held its first competition for the cup and tankard generously given by Major T. G. Bird, D.S.O., and Mr. J. E. Hurst, respectively.

Perhaps the absence of this material, so familiar to all foundrymen during the week, was responsible in some cases for the exceptionally good performances, and in others (those whose work is nearest to their hearts) to the rather high scores which they returned at the end of the day. In spite of the scarcity of sand bunkers, the course was by no means easy, as many of those who were present would be willing to testify. Nevertheless, from wherever one was playing, whether it was on the 12th green about the 9th hole. In addition to the players, Mrs. Bigg, Mrs. Lockwood, Mrs. Stubbs and Mrs. Pearce went along to lend support to their husbands, and Mr. and Mrs. J. E. Hurst arrived later in the day to greet the players at the 17th green, and to encourage the tired and weary, who had had to carry their own clubs because of a shortage of caddies on Sundays, by reminding them that each stroke brought them nearer to tea, or at least to the club-house.

After tea, Mr. Bell announced the winners of the cup and tankard, and after Mr. Scott had replied, Mr. C. W. Bigg thanked the officials of the club for their hospitality and expressed the hope that even more members would participate in the competition in future years. Mr. E. L. Edwards replied on behalf of the club. A hearty vote of thanks was expressed by the President to Mr. J. Bell, who had contributed so largely to the success of the most enjoyable day. The prizes will be presented to the winners at the annual banquet of the Institute in Bradford on June 15.

CAMERA SHOTS AT MATLOCK. ON THE RIGHT IS MR. WILLIAM SCOTT, WINNER OF THE CUP FOR THE BEST NET SCORE. ON THE LEFT IS MR. E. A. PHILLIPS, WHO WON THE TANKARD WITH THE BEST GROSS SCORE. THE GROUP IN THE CENTRE INCLUDES MR. C. W. BIGG (PRESIDENT OF THE INSTITUTE OF BRITISH FOUNDRYMEN), MAJOR T. G BIRD (DONOR OF THE CUP), AND MR. WILLIAM SCOTT.

perched high up on the hill, or from the "rough" beneath some hawthorn bush on the way to the 16th, one could not but enjoy the lovely views and surroundings.

Many players seem to have made not a day but a good week-end of the competition, and those who were not engaged in sampling the waters(?) of Matlock seem to have spent the previous Saturday evening listening-in to the frequent weather reports, which were, fortunately, proved incorrect. The weather, in fact, was fine, with just a shower or two to freshen up the flagging spirits of those whose shots compelled them to negotiate several steep ravines. There was, however, a strong wind, and although it helped players along quite well on the 510-yd. 2nd hole, it also played considerable havoc with drives from such tees as the 4th and 7th.

The standard scratch score ("bogie" to the experts) for this course is 70, and Mr. W. Scott played a very fine game to win the cup presented by Major Bird for the best net score, for he went round in 67 on a handicap of 16. Mr. Robiette returned a card of 68, which secured for him the second place. The best gross score was made by Mr. E. A. Phillips, who had a round of 80, which was two strokes better than Mr. Wilson, who won second place. Mr. Phillips, therefore, became the first holder of the tankard presented by Mr. Hurst.

In all, eighteen members entered for the competition, but Mr. "Jimmy" Bell, who had carried through the arrangement for the competition so admirably, was apparently so disgusted with himself that he tore up his card at

The players taking part in the competition were as follow; their gross and net scores are given in that order after their names:—Major T. G. Bird, D.S.O. (88, 73); Mr. C. W. Bigg (109, 85); Mr. W. Scott (83, 67); Mr. E. A. Phillips (80, 71); Mr. A. G. Robiette (88, 68); Mr. F. A. Wilson (82, 72); Mr. E. R. Briggs (94, 79); Mr. H. W. Lockwood (102, 82); Mr. J. G. Pearce (111, 87); Mr. R. Stiles (101, 77); Mr. R. C. Shepherd (84, 74); Mr. A. Swain (110, 86); Mr. R. Stubbs (98, 81); Mr. G. P. Tinker (88, 76); Mr. H. Wharton (99, 79); Mr. E. Butler (91, 81); and Mr. A. Stokes (83, 70).

The Use of Cast-Iron Borings

(*Continued from page 437.*)

Cost of Compressing Cast-Iron Borings

The briquetting cost amounts to 8s. 5d. per ton for large plants and 14s. 9d. per ton for small. As to the filling up of canisters using pneumatic rammers or small 5 atm. air-presses, the cost may be calculated as follows:—

	s.	d.
Canisters, per ton of borings ...	6	7*
Labour for filling up canisters, per ton of borings	2	2
Compressed-air plant upkeep and amortisation, per ton of borings...	4	5
Total	13	2

As borings are at present sold in Italy at 300 lires per metric ton, it is obvious that it is very advantageous for a foundry to make use of its own borings in the cupola even in the case where borings are cast into pig. In this instance, although economically not very favourable, no chances are left for troubles in the castings, and the cost may be set out as follows:—

	£	s.	d.
Borings packed in canisters ...	3	16	7
Labour, furnace men and assistants		4	5
Coke, 20 per cent. at 300 lires per ton		16	0
Loss 8 per cent.		8	0
Cost of pig	£5	5	0

Finally it should be pointed out that the remelting process in metal canisters can be successfully extended to use up all cast-iron flash, fins and other small residues emanating from the magnetic separators or riddling plant. This material amounts to 3 to 6 per cent. of the produced castings; serious consideration should, therefore, be given to the means of making the best use of it. The tests show that this class of scrap mixed with about 25 per cent. of borings can be compressed in the metallic canisters so as to give a compact lump. Under these conditions the losses from oxidation are considerably lower than those resulting when melting with 100 per cent. of borings.

(*Concluded in previous column.*)

(*Concluded from next column.*)

Conclusions

(1) Producers of cast-iron borings ought to collect and preserve them with the greatest care for their own and for their country's benefit. A special container ought to be used for each machine-tool producing borings.

(2) In the main industrial areas special cast-iron borings-collecting centres ought to be installed, to remelt borings by means of a special electric furnace working during the night.

(3) The iron foundries attached to engineering works can remelt their own borings in the cupola furnace with advantage by choosing the method which best suits their own particular conditions (briquetting or compression in metal cans; additions of 10 to 30 per cent. of borings to the normal charges to be directly poured into castings; production of pig using 100 per cent. borings).

* Canister containing 22 lbs. of borings costs three farthings and weighs about 1¼ lb. Strictly, the canister cost ought to be only partly reckoned, as the canister plating which has been paid for at 0·375d. per kg. adds to the weight of the molten metal produced.

Controlled Foundry Sand

DISCUSSION IN BRADFORD

The Paper on "Moulding Sand with Special Reference to Blind Scabs,"* which MR. S. CARTER and MR. A. W. WALKER presented to the West Riding of Yorkshire Branch of the Institute of British Foundrymen, evoked a discussion which touched on a variety of points relating to sand practice and sand research.

Coal-Dust and Silica Sand

MR. A. S. WORCESTER (Past-President) opened the discussion by expressing the opinion that coal-dust additions to a silica sand gave a green bond strength to that sand, which strength increased with milling after each cast. He suggested that this was proof of the contention that coal-dust additions did give an extra bond to sand, most probably because of the tar distribution around the sand grains. He had experimented along those lines and had produced a good mouldable sand, which was not easily scabbed.

MR. A. W. WALKER, replying, said it was a fact that a synthetic sand could be built with coal-dust additions to silica sand, but the green bond strength was not obtained by a tarry bond coating over the silica grains. Many writers on sand had hastily accepted this function of coal-dust, but an examination of the fusing points of coal-dust or tar destroyed the conception utterly. What most likely occurred was that, by the destruction of the coal content, a rough carbonaceous film coated the silica grains, thereby giving an increased mechanical strength to the sand. The more often the sand was used, the rougher this coating became. At the same time, Mr. Walker continued, the excessive addition of an element which was so prone to the evolution of gas was to be deplored. Why should one bother with synthetic sands in a country so rich in naturally bonded sands as this country? The only argument in favour of the continued use of coal-dust in the foundry was the one of economy. The day would come when the foundry world would look on the use of coal-dust as an anachronism.

What is a Synthetic Sand?

MR. F. K. NEATH (Past-President) remarked that, although Mr. Walker had stated he saw no need for synthetic sands in this country, he had evidently developed something in the nature of a synthetic—or, at any rate, a controlled—sand himself, whether scientific or natural; and he had justified it by results. The key of the matter was the need for a bond if the sand was of a very smooth grain.

MR. WALKER said that no claim was made by the authors that a synthetic sand had been produced, and before a sand such as that dealt with in the Paper could be produced, a good base sand must be in existence. The addition of a colloidal substance such as bentonite to a bad sand would not convert it into a good sand. One could add bentonite to a sand and inherit all the bad points; it was no cure-all. As Mr. Neath had qualified, however, the sand was a rigidly controlled sand.

Accelerated Air-Drying

MR. D. W. HAMMOND (Bradford) asked whether the authors had any experience of the accelerated air-drying effect on a moulding sand, when a colloid was used, and whether the addition of starch in one of its forms or some such bond had been used to maintain dry bond strength. Again, in regard to coal-dust, did Mr. Walker think that, distinct from the effects of any volatile constituent in the coal-dust, the coal-dust had other beneficial effects which gave it value in producing moulding sands?

MR. WALKER said the use of bentonite certainly had the effect of accelerating the act of air-drying, but the slight addition of 5 per cent. moisture took care of this in the green sand. Starch in none of its forms had ever been used to maintain dry bond strength, nor had bentonite or any other colloid been used directly. As the controlled sand with which they had dealt was a single base sand—*i.e.*, all sand in use in the foundries, whether green sand, dry sand, oil sand or loam, was returned through the knock-outs to the storage hoppers, where it was mixed indiscriminately—it therefore followed that a certain percentage of bentonite must exist in all sand as it left the system in its reconditioned state. The higher dry bond strength which had obtained since the introduction of bentonite to the green sand undoubtedly showed the benefit of bentonite as a promoter of dry bond strength. However, the dry strength of the dry sand was maintained by the addition of 0.3 per cent. of a wood pulp compound. No new sand additions were required. Regarding the value of coal-dust, its greatest value was that of a distributer of carbon over the mould face. The authors were of the opinion that during contact with the metal, destructive distillation of the coal-dust took place. This was so rapid that the tar and other volatiles had not time to function as generally supposed, but the residue of destruction (free carbon) covered the mould as a refractory of extreme value, and protected the mould as such, not as a smoky screen.

Blind Scabs

MR. J. FEARNSIDE (Keighley) asked whether the fault known as blind scabs, or buckles, arose from the same cause when they occurred on the top part of a casting as those which occurred on the bottom of a casting.

MR. WALKER replied that relatively the cause was the same. The occurrence only took place with green sand, or with a dry-sand mould improperly dried, but never with a correctly dried mould. Mr. Carter had related the various faults which helped to form this type of defect. The authors rejected the theory of silica grain expansion as the cause. Top-scabbing could occur through the causes set out in the Paper, and could be also developed by (in the case of a flat top) having open risers or top venting. To their minds, when casting jobs having a flat top, no venting should take place, and all risers should be perfectly sealed. If either of these precautions was omitted, the air and gases escaped too readily, taking away the protection which should be afforded between the face of the metal and the sand of the cope. The steam generated from the rapidly drying cope would try to force its way into the mould, and cause the same fault as in bottom scabbing. As the metal rose to the top, the disturbed sand was filled with metal, giving exactly the formation of defect which was found with bottom scabbing.

Clay on Gaggers

MR. J. J. WATSON (Huddersfield) asked whether the authors ever thought that too much lime content in the clay on a gagger, causing a lowering of the fusion point of the sand directly underneath the gagger, might be a reason why scabs occurred in the vicinity of a gagger.

MR. WALKER said he would not like to venture an opinion on the correct analysis of a clay for the purpose, but he hardly thought that scabbing would occur from the cause mentioned by Mr. Watson. More likely causes would be having the gagger too wet, too near the face, or knocking it during ramming. A gagger, after dipping in the clay-wash, should be plunged into the sand heap.

Silica Expansion

MR. J. BLAKISTON (Halifax) said he was familiar with the methods employed by Mr. Sheehan in controlling foundry sand, and he could say that every satisfaction was being derived therefrom. He was particularly interested in the points raised in connection with coal-dust and silica grain expansion, and he noted with interest the authors' statement regarding the value of coal-dust at casting temperatures. Had the authors borne in mind that, during carbonisation, an expansion took place at 600 deg. C., and a contraction at a later period? There was also the possibility of fixed carbon and its consequent effect on moulding sand during casting. The authors appeared to have proved conclusively that sand expansion in itself did not affect mould values, but having in mind major expansion figures at temperatures around 200 and 650 deg. C., it appeared feasible to suppose some change in structure when these expansions took place, and he would like to have the opinion of the authors as to what it was that offset the change.

MR. WALKER, in reply, stated that from the course of the experiment undertaken in connection with the Paper, the function of coal-dust as a bonding agent, or as a "buffer" material, ceased long before the major expansion point mentioned by Mr. Blakiston. In addition, if sand expansion were taking place at these temperatures (about 600 deg. C.) it would follow that sand buckles would not be produced in moulds poured under that temperature. Confirming this, Mr. Walker showed a section of an aluminium casting poured at 600 deg. C. with a perfect example of a dumb scab and as had been stated in the Paper, this defect had been obtained consistently over a range of temperatures from 600 to 1,400 deg. C. However debatable the sand expansion temperature might be, the authors had not found any investigator who placed the figure below 600 deg. C. Mr. Walker further said that a mould was not a homogeneous structure. It did not have its multitude of sand grains in definite longtitudinal or lateral arrangement, and the interstices provided any amount of freedom for expansion should such action take place.

New Sand Additions

MR. H. ROBERTS (Leeds) suggested that it would be necessary to introduce new sand into the mixtures again at some future date. If not, perhaps some addition, such as a colloid or a compound of wood pulp, would be necessary to give the present sand a more or less indefinite life.

MR. WALKER said that the point was one of extreme interest. Owing to the grain growth which occurred through burning on, and the combining of sand grains into compound grains, an apparent increase of the larger sized grains occurred. The word "apparent" was used, but the authors were not fully convinced that the full measure of grain size increase was told by grain growth. On the graphs showing the green bond strength of various sized grains it would be noticed that the green strength of the 16-mesh grains was the greatest. Probably on washing it would be found that this size of grain contained the bulk of the bond. Thus, when those combined grains were broken down, the bond was redistributed, so that, as Mr. Roberts suggested, it might be possible to keep the sand alive simply by the addition of extra bond.

Interchangeability of Bonds

In reply to a member who asked whether the authors had any data concerning the washing of sands and the interchanging of the bonds from one sand to another, MR. CARTER replied that the authors washed clays from several sands, but had no definite figures available. However, it was apparent that the red sands

(*Concluded on page* 440.)

* See the JOURNAL last week, pp. 423-8.

All-Welded Foundry Extension

The addition of a new building which has been equipped principally for core production, has considerably enhanced the manufacturing facilities at Head, Wrightson & Company's Thornaby Steel Foundry, producing carbon and special alloy steel castings. This recent extension, which is of all-welded construction, has been erected adjacent to the existing foundry buildings. The total length is 155 ft. divided into seven bays, the height to eaves being 29 ft., and a 5-ton crane spans the 35-ft. width. The new building is of the rigid-frame type of design extensively developed by the company, and provides a maximum amount of space from floor to roof by the elimination of all angle trusses, framing, etc. The complete design, manufacture, and erection was carried out in the company's own departments.

THE ALL-WELDED EXTENSION TO THE THORNABY STEEL FOUNDRY OF HEAD, WRIGHTSON & COMPANY, LIMITED.

Revival of Basic-Bessemer Process in Poland

The Kattowitzer I. G., formed by merging the principal Polish iron and steel works, the Königs-Laurahütte, Bismarck-Hütte, Kattowitzer A.-G. and Silesiahütte, and after the Polish State Railways the largest industrial concern in Poland, has for some time been studying the potentialities of a new basic-Bessemer steelworks from which the output would radically alter the export capacity of the Polish iron and steel industry. Basic-Bessemer works were in operation at the Friedenshütte and Königshütte before the war but had been abandoned, and later dismantled, owing to the absence of suitable pig-iron, a high phosphorus burden being very costly and Polish coal being unsuitable for smelting to low-silicon basic iron.

The concern has now overcome these two primary difficulties. Large resources of low-grade phosphoric ores are available in Poland but are difficult to smelt. The erection of a new blast-furnace plant with modern hot-blast stoves has allowed a good-quality basic iron to be produced from Polish ores. This can only be achieved on a commercial scale, however, by an adequate supply of a better quality of coke. The Kattowitzer I. G. therefore proposes to utilise the excellent coking coal from the Dembiensko Colliery and to build a washing and screening plant so as to yield a coke almost as good as the Rhenish-Westphalian product, but much cheaper to produce. The capacity of blast furnaces has been steadily increased during recent years, the average capacity being now 400 tons per 24 hrs., while new furnaces with a much higher capacity are projected. Basic-Bessemer iron has already been made for several months past and worked up by the pig-iron/ore process, furnishing a good phosphoric slag. When the projected basic-Bessemer steelworks is in operation, it is also expected that the bulk of Poland's requirements of basic slag will be covered from home sources; at the moment imports of basic slag are heavy.

Controlled Foundry Sand

(*Concluded from page* 439.)

held their bonds more tenaciously than yellow sands. This followed the general conception that sands bonded with ferric oxide were likely to give a longer life.

MR. H. HARRISON (Bradford) said that he was a believer in coal-dust. If one used a good clean sand, and a good coal-dust, decent castings should be obtained. Coal-dust was to his mind the finest thing available. He felt if there was a little less experimenting, there might be better results. The sand talked about probably made only light castings.

MR. WALKER agreed that coal-dust was excellent as a matter of economics. So far as concerned the suggestion that one might do better with less experimenting, the authors definitely could not agree. It was retrogressive to decry research, and denied the utility of the Institute as a whole. They had every reason to be satisfied when they did get good results, but that was no reason why one should not ascertain if it were possible to get even better. The controlled sand made castings from a few ounces up to 16 tons, and was quite capable of being used for castings of much heavier weights. When founders realised the money that was lying idle in their foundry floors, due to the excessive and wasteful use of new sand, only a very small proportion of which was ever used, probably the research antagonism would have to be greatly modified. After all, a foundryman should realise that a foundry existed on its profits.

Vote of Thanks

MR. E. GREAVES (Halifax) moved a vote of thanks to the authors, which was seconded by MR. F. SQUIRES (Bradford).

MR. WALKER, replying for the authors, asked the meeting to consider their Paper as the first stage embracing further investigation. Work which was in course of development would, it was hoped, supplement the conclusions already arrived at. If it was the wish of the Branch at some later date, when this work was completed, the results would be set before them.

Notes from the Branches

Wales and Monmouth Branch.—Members of the Wales and Monmouth Branch and the Bristol Section of the Institute of British Foundrymen visited the Stanton Ironworks, at Stanton, Notts., last Thursday. There was sufficient in number to charter a special coach on the L.M.S. from Gloucester, and on arrival at Derby the party was conveyed by motor coaches to the Stanton Works, where luncheon was served in the works dining rooms.

Mr. T. Sarson (assistant managing director), accompanied by Mr. P. H. Wilson (foundry general manager) and Mr. A. Watson (manager of the iron pipe department), presided at the luncheon, at the conclusion of which the party was conducted by guides over the blast-furnace plant, where they witnessed the tapping of one of the furnaces. They then visited the latest addition to the pipe-spinning plant, where pipes two and three inches in diameter were being spun; the concrete pipe spinning plant, and, finally, the older part of the iron pipe-spinning plant, where the larger sizes of pipes are produced. At the conclusion of the tour the visitors were entertained to tea, and Mr. J. J. McClelland proposed a vote of thanks to the staff and to the company for the courtesy shown to them during the visit. This was seconded by Mr. S. Protheroe.

East Anglian Section.—A party of about thirty members of the East Anglian Section of the Institute of British Foundrymen visited the works at Colchester of Davey, Paxman & Company (Colchester), Limited, last Thursday. They were accompanied by several members of the London Branch. The party was received by Mr. T. Brazier (works manager), who, with Mr. H. Todd (foundry foreman), conducted them round the works. Some time was spent in the foundry, which has recently been modernised by the introduction of new equipment, and which is engaged largely in the production of castings for diesel engines ranging from 15 to 15,000 h.p., filtration plant, paint machinery, and ammonia compressors of all kinds. Afterwards, the patternshop, the extensive boiler shop, erecting shops and machine shops were inspected.

At the conclusion of the visit the members were entertained to tea at Wright's Restaurant. On behalf of the guests, MR. L. J. TIBBENHAM (chairman of the East Anglian Section) thanked the company for the courteous reception which had been extended, and for the opportunity the members had been given of inspecting so interesting a works. The foundry they had seen, he said, was for making special castings, and it was a treat to see skilled moulders and coremakers still at work.

MR. BRAZIER, responding, conveyed the regrets of Mr. P. A. Sanders, O.B.E. (managing director), that he had been unable to be present at the works that afternoon. A considerable sum of money had been spent on the foundry in the past year, and he was glad that the visitors had had an interesting afternoon.

MR. J. L. FRANCIS (hon. secretary of the Section) also expressed the thanks of the party for the facilities the company had provided.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Templewood Engineering Company, Limited, 490, Ipswich Road, Trading Estate, Slough.—Capital £10,000. Directors: S. S. Tresilian, A. C. Bertelli, S. Sanders and L. Jackson.

Adamson-Alliance Company, Limited, Ingram House, 165, Fenchurch Street, London, E.C.3.—Capital, £500. Engineers, etc. Directors: G. R. Adamson, J. Adamson, J. W. C. Conquest, H. Fennerty, A. V. Flinn and H. Kendall.

White Cast Iron*

By P. L. WARD, B.Sc.

White cast iron is used as an abrasion and attrition resisting medium in the form of balls and liners for mills, pump impellers and liners, shute and launder liners and so on; also in its other use as a corrosion and heat resister in the form of rabble arms, fire bars, annealing pots, etc. In the production of this material founders are accustomed to synthesise it to a certain extent for two reasons: firstly, to keep the carbon content down to a reasonable limit and secondly to keep the cost down, steel scrap being cheaper than white pig-iron.

In South Africa most of the white iron produced is cupola melted, although a certain amount is duplexed in a cupola and electric furnace. It is with the cupola-melted material that this Paper will deal.

For attrition and abrasion resistance the object in view is to produce an iron which has reasonable casting properties, is fairly close-grained and tough, and yet is hard; for resistance to heat a softer and tougher iron is desirable but it must still be white. Locally, the following raw materials are available: pig-iron, grey cast-iron scrap, white iron scrap and steel scrap, coke and limestone. Of these, white iron and steel scrap are liable to periodic shortage.

For wear-resisting purposes an iron must be white right through its section, which may be as much as 5 in.; this will entail a fairly strict silicon control, and without using such alloys as chromium to keep it white the silicon content of iron for a heavy green-sand casting should not be much above 0.6 per cent. Sulphur should be as low as possible. Using local scrap and coke, this cannot be kept much below 0.2 per cent. Phosphorus should also be reasonably low, under 0.3 per cent. Manganese should be sufficient to balance the sulphur. Carbon should be between 2.7 and 3.0 per cent.; the actual carbon content can, of course, be adjusted by varying the mixture used, *i.e.*, raising the pig-iron content will increase the carbon, and increasing the steel percentage will lower it. The hardness of the material described will be between 390 and 410 Brinell on a 2-in. section and would give good results in an abrasion test.

Melting Practice

In melting large percentages of steel scrap, particularly when this scrap is often heavily rusted, the refractory lining of the cupola needs particular attention. In melting ordinary white iron mixtures in cupolas of various sizes up to 42 in. diameter, the author has observed that the erosion in the melting zone is about half an inch in diameter for each ton melted: with such wear occurring, heavy daily repairs are essential, and ganister well bonded with fireclay has proved a speedy and satisfactory material for all repairs from about 4 ft. above the tuyeres downwards: above this, owing to pounding of the cold metal during charging, firebrick is the best material for lining and repairs.

Local coke, being high in both sulphur and ash (0.7 to 1.0 per cent. and 12 to 15 per cent. respectively), needs careful handling. The ash requires additional limestone for fluxing, and a fair proportion of the sulphur will find its way into the iron unless an excessive limestone burden is carried or soda ash or similar flux be employed. The author has found the melting ratio in a hot cupola in its stride, using steel scrap in a fairly high percentage, to be about 8:1 metal to coke, and is about the minimum of coke possible.

In justification of this ratio, which seems very extravagant indeed, compare it with a ratio of 10:1 for straight grey iron in a normal cupola using a coke of about 8 per cent. ash and 88 per cent. fixed carbon: there is 100 lbs. of coke containing 88 lbs. of available carbon, all of which can be used for burning and none for carbon pick-up. In the case of white iron, there is a fixed carbon of about 84 per cent. and a carbon pick-up of about 1 per cent. of the iron charge, which means that, of 100 lbs. of coke, 84 lbs. of carbon is available for burning and of this about one-twelfth is required to furnish the necessary carbon, or 100 lbs. of coke will only give 84 − 7 = 77 lbs. of carbon for burning or 77/88 or 87.5 per cent. of the efficiency of the 10:1 example for grey iron, which brings a ratio of 10:1 down to 8.75:1. If the heat required for converting the high ash and rust content to slag and to superheat the iron be considered, a ratio of 8:1 does not appear quite as bad.

The size of charge will be limited by the size of ladle in use, the well capacity and diameter of the cupola. With a 1-ton ladle and 42-in. cupola, charges of 1,000 lbs. should be the maximum; the coke bed should be measured by height above tuyeres and the subsequent coke charges should be made by weight. In cupola operation using high steel percentages, a good bed is required, and the first or leader charge should be of grey or mottled iron so that it will flow readily and not cause trouble by setting in the cupola well or tap-hole. This iron is allowed to run over the spout as it melts, thus warming the tap-hole and well. When the iron appears sufficiently warm and it is certain that the high-silicon iron has been melted, the tap-hole is closed and melting proceeds. As the first ladle of metal tapped may be rather sluggish, this metal should only be used for unimportant work, or better still it should be pigged. It is most important that full use be made of the preheating zone of the cupola and that until charging stops for the day the cupola be kept as full as possible. If the charges are allowed to get too low, dull and badly-melted iron will result, and the remedy may only be to rebuild the bed, in the meantime pigging the molten iron of doubtful quality.

The author favours a single row of tuyeres of large size and as soft a blast as possible—12 in. of water gauge in a 42-in. cupola is ample. If possible a volume gauge as well as a water gauge should be fitted on all cupolas.

Moulding

As regards moulding there are a few points which are worthy of particular emphasis. The sand itself must be more refractory than in general grey iron practice, as the molten iron in white iron practice is both hotter and of a more searching nature. As the majority of work, even up to 5 in. in section, is done in green sand, the sand should be fairly open in texture, reasonably strong and with a minimum of silt. Coal-dust to the extent of 8 to 10 per cent. by weight will assist in giving castings that strip fairly well; this material also helps in producing a reducing atmosphere in the mould which is beneficial. In green-sand work no plumbago has been found which would give as good results as those given by talc as a mould finish. Moulds and cores should be particularly well vented; this remark also applies if chillers are used as part of the mould.

The use of chill moulds, and chillers as an integral part of the mould, is common in this type of work. One of the reasons for this practice is that it assists in eliminating or at least in reducing the porous area of loosely-packed crystals in the last portion of metal to freeze. As a means of hardening iron a chiller is not effective to any great extent; in an iron which would be white a chill might only raise the hardness by 10 points in the metal adjacent to the chill itself. Various chiller coatings have been tried, such as plumbago and water with molasses or dextrin; sodium silicate and water: sodium silicate, plumbago and water; silica flour, molasses and water, and several combinations of these. A coating which contains no water and gives good results is a mixture of plumbago and thin oil, applied sparingly to the chill surface. Of course, chillers should be well dried before use and placed in the mould in a warm state; a strong point in favour of the use of oil is that a chiller coated with this material is not as liable to pick up mould moisture as other water-carried coatings.

As regards material for chillers, a close-grained grey iron of low silicon content, about 1.5 per cent., appears very satisfactory. Rejection is usually through surface cracking or crazing and occasionally through warpage; the life of the chiller may be between 30 and 120 casts, depending on the section of the chiller and the section of the coating against it. In connection with the life of chillers it might be mentioned that careless placing of runners is apt to cause loss through the metal stream striking the chiller for an appreciable period during the filling of a mould; if this occurs the surface of the chiller may be fused and will cause the chiller and casting to be burnt together at the point of impingement, and will probably result in the scrapping of both chiller and casting.

Pyrometry

Temperature control is as important in white iron as in other metals. Dull iron is dangerous in that it may be fluid enough to run a casting and give to outward appearances a sound casting, yet on fracture the job may be full of pin-holes due to evolved gas which was unable to escape before solidification of the metal. With synthetic white cast iron, temperatures on the whole are considerably higher than those of ordinary white iron derived from pig-iron; these higher melting and freezing temperatures can be accounted for by the lower carbon content, slightly lower silicon content and the general slightly oxidised nature of the synthetic material.

A pyrometer of the immersion type is not entirely satisfactory. If a noble couple be used, *i.e.*, platinum-rhodium, it must be encased in a refractory protecting sheath, and the time taken by the unit to attain metal temperature will be excessive. An alternative is a base metal couple; here again the sheath is out of the question, and the wires of the couple are placed in the metal, which completes the circuit. The wires are protected up to their ends, and the sheath is broken away when necessary to expose more wire: about ¼-in. of wire is burnt away for each reading; here again there is a time lag in attaining the true temperature. Slag bridging the couple will also cause erratic readings.

A more suitable instrument for the purpose is one of the disappearing filament pyrometers, in which the temperature is measured by matching the filament of a standard lamp against the molten iron, and in such an instrument there is no contact with molten metal, readings being taken at a distance of eight feet or more from the iron. The pyrometer, after focusing, is sighted on to the metal stream as it leaves the furnace spout or ladle. Very consistent readings are obtainable, and the only maintenance required is the recharging of the single cell accumulator and occasional renewal of the leads between accumulator and instrument.

The temperature, as indicated on a Foster pyrometer, of metal leaving a 42-in. dia. cupola is about 1,360 deg. C., and casting temperatures are approximately, for 1½-in. section jobs, 1,280 deg. C.; 3-in. section 1,270 deg. C., and 5-in. section 1,260 to 1,250 deg. C. According to the makers of the instrument a correction of about 90 deg. C. should be added to the readings

* Section of a Paper presented before the South African Branch of the Institute of British Foundrymen and printed in the "South African Engineer and Foundryman." The first part of the Paper was a brief survey of the history of white iron for malleable work.

obtained when using the instrument in the open on a metal stream; the instrument is calibrated to give correct readings under black-body conditions: that is, when the body whose temperature is required is both radiating and receiving light. Such a condition is fairly closely attained in an enclosed furnace, such as is used for annealing, when the pyrometer is sighted through a peep hole. The fact that such a correction is necessary might appear as a weakness in the system advocated, but the fact that consistent readings can be taken day after day, and that each reading only takes about 5 secs., greatly outweighs any disadvantages. For internal purposes in any foundry what is required is a set of temperatures for day-to-day comparison; if necessary the figures can be corrected by the addition mentioned; the author, however, prefers to use the figures read direct from the instrument, noting if necessary that such figures are uncorrected.

In connection with temperature control, it is, of course, always advisable to melt as hot as possible and to allow the metal to stand until it reaches the correct casting temperature.

THE EFFECT OF CONSTITUENTS OF WHITE IRON

Carbon

Carbon, provided that it is all retained in the combined state, is a hardener; in other words, the higher the carbon the harder the iron, other constituents remaining the same. However, for castings which are to withstand shock or pounding in service there is a limit to the carbon content, as excessive cementite causes embrittlement and consequent liability to fracture in service; as mentioned previously, a suitable carbon percentage is between 2.7 and 3.0 per cent. A further effect of carbon is on the melting point of the iron, low carbon iron being more difficult to handle in the molten state.

Silicon

Silicon is a vitally important element and should be controlled with great care; excessive silicon will, of course, tend to cause mottling, particularly in a dry-sand job when the cooling will be slower than in green sand. However, up to the point where severe mottling takes place, silicon would appear to have an indirect hardening effect, possibly due to a slightly higher carbon content; this has been noted by the author and is put forward as an explanation with full realisation that it is an accepted fact that a low silicon goes with a high carbon content and *vice versa*. A further point in favour of a fairly high silicon content is that the metal is easier to handle and gives, in general, sounder castings than metal with a low silicon content; it might be mentioned that the author regards a high silicon iron as having 0.6 per cent. Si and over, and a low silicon iron as having 0.3 per cent. of Si and under.

As a possible explanation of the high-silicon: high-carbon phenomenon, the following experience might be related. During a temporary shortage of grey cast iron of about 2 per cent. silicon, a consignment of iron was received and used immediately, standard mixture and melting practice being adhered to. About an hour after the new iron mixture had been charged, the slag was seen to be viscous and, after running on the ground, it puffed up to about five times its original volume; the next ladle of metal appeared normal but with a slight tendency towards lifelessness; the slag in the meantime was getting steadily worse and the following ladle was still hot but lifeless, and, when cast, the iron in the runner bushes actually rose up instead of sinking. A check on cupola practice showed that all factors appeared normal—coke, air and metal charges; and, in spite of suspecting a low bed, increased coke did nothing to improve the position. On looking at the castings the following day they were found to be full of small bright-walled pinholes and looked very much as if yeast had been put into the metal. Analysis showed that the particular consignment of grey iron only contained 1.3 per cent. silicon and that the bad castings analysed 0.2 per cent. silicon; 2.52 per cent. carbon, and 0.16 per cent. manganese instead of about 0.6 per cent., and the hardness 370 instead of 400. The remedy adopted was to increase the percentage of low silicon grey iron in the charge at the expense of the white scrap and thereby to increase the silicon content of the charge; a perfect melt was then obtained. Of course, a similar result would have been obtained by the addition of ferro-silicon to the charge.

In the instance given, the silicon content of the charge was about 0.55 per cent. instead of about 0.8 per cent. This apparently small deficiency in silicon was evidently responsible for upsetting the normal smooth melting conditions to such an extent that the iron either did not pick up its quota of carbon or more probably lost some carbon; the silicon loss was excessive and probably due to the generally oxidised state of the iron. The manganese which was added to the ladle was absorbed in deoxidising the iron and very little remained in the iron itself. This trouble has been observed on one or two occasions since, particularly when melting abnormally high steel percentages with rather too low a silicon content in the charged metal. In general a charged silicon of 0.9 per cent. will give 0.6 to 0.5 per cent. of silicon in the molten iron, *i.e.*, a loss in silicon points of 0.3 to 0.4 per cent.

Manganese

Manganese serves two or three purposes: firstly, it is a fairly strong deoxidiser; secondly, it combines with sulphur to form maganese sulphide; thirdly, it has a distinct hardening effect. If manganese be progressively increased in a white iron, it will first have a slight softening effect until the sulphur balance point is reached, after which it acts as a hardener. Some tests carried out by the author on an American washed iron of the approximate composition, 3.5 per cent. C, Si and Mn under 0.1 per cent., P and S under 0.02 per cent., might be of interest, and are given below. The silicon was raised to 0.6 per cent. to give an iron of reasonable casting properties, and the manganese was progressively increased to 15 per cent., melting being done in a gas-fired crucible furnace and fresh base iron used for each melt; casting was done in sand, and a step-bar test-piece was cast with each composition.

Number of melt	1	2	3	4	5	6
Approximate Mn %	Trace	2.5	5	7.5	10	15
Hardness: 1-in. section	389	429	526	601	569	542

The higher the manganese, the sounder was the casting, and those above 5 per cent. Mn stripped well. The fractures got steadily coarser up to 7.5 per cent. Mn, at which point the metal was composed of large plates and was extremely brittle; above 7.5 per cent. Mn the structure became finer and the metal less brittle. In using manganese as a desulphuriser, the longer the metal can stand in the ladle after trapping, the better, as this allows some of the light manganese sulphide to separate and float.

Special Elements

Chromium has the normal hardening effect met with when this material is added to grey iron; the metal is also made more brittle with large chromium additions. With about 15 per cent. Cr, the structure changes from a silky close grain to an acicular structure, and in this state, and up to about 25 per cent. Cr, the iron becomes a remarkable corrosion and heat resister, being very resistant to growth and scaling; its properties as an abrasion resister are also good, and a high chromium iron finds application in sand-pump spares, where it gives lives over 200 per cent. of the life of ordinary white iron.

Sulphur and Phosphorus are undesirable, due to their embrittling action and tendency of the former to cause hot tears and cold cracking.

Nickel has no great effect on hardness until about 4 per cent. Ni is reached, when the iron tends to become martensitic in structure, and at about 5 per cent. a hardness of about 570 is reached on a 4-in. section.

Aluminium is occasionally used as a deoxidiser, at which duty it is very efficient, but it must be borne in mind that this metal has a marked softening effect; six ounces of aluminium added to 1 ton of iron reduced the hardness of the resulting castings from 400 to 340. The general effect of aluminium is to promote graphitisation until a certain percentage is reached, when the iron becomes white again.

General

When using large scrap percentages, some form of deoxidiser is essential, otherwise the iron will be prone to gas formation in the mould, irrespective of mould conditions. Slag particles in the metal cause cavities in castings out of all proportion to the size of the particle. Excess moisture in the sand, or the use of sand too close in texture, will cause pinholes in re-entrant corners of castings.

White cast iron, due to its high liquid and solid contraction, is liable to be slightly porous in the last portions to freeze; this tendency to porosity will be less in well-deoxidised fluid iron than in a dirty metal. Usually a suitable change in runner for a particular casting showing porosity to an excessive extent will help the position. Well-deoxidised iron poured too hot will often leave a ragged local sink or draw near the runner. Temperature control and runner design are the remedies. Risers directly over a job cast in a true white iron seldom give satisfaction, whether rod fed or not, a cavity usually being found on breaking off the riser.

Testing of Castings for Abrasion Resistance

The testing of a white iron experimentally presents many problems. For instance, a comparative test carried out using a grindstone will not necessarily correspond with results obtained under practical conditions; also, it is most difficult to keep the conditions constant for the duration of a test. The most promising method would appear to be one in which marked and weighed balls of the various alloys to be tested are run in a small ball mill crushing some abrasive material, the loss in weight after a definite period being an index of wear resistance.

One routine test that is easily carried out is that of hardness testing: a difficulty that presents itself is that a white iron cannot be readily cut or filed to convenient sizes as can grey iron. However, with a cold set suitable specimens about an inch square and quarter thick can usually be obtained. These are carefully ground true and, if necessary, further polished on emery papers. The testing machine can either be the standard Brinell machine or preferably, a smaller instrument in which a diamond is used instead of a ball; this preference is due to the fact that the ball suffers slight distortion on a hard material which may become permanent and so give erratic results. The Firth "Hardometer" is a convenient and simple instrument which has given good service; this instrument will operate on balls or a diamond and for white iron the diamond is always used. One particular advantage of this machine is the adjustable base, with which it is not necessary to have the top and bottom faces of a specimen parallel. This is a factor saving much time in specimen preparation. In use the impression is made by the pyramid diamond and the diagonals are measured and meaned; as a rule five impressions are made, measured, noted and averaged in about 3 min. The results after correction from a chart compare very well with standard test-pieces.

Analysis

In this connection a few remarks on drilling samples will not be out of place. A white iron

(*Concluded on page* 443.)

The New Factories Act—VI

SOME MISCELLANEOUS PROVISIONS

By F. J. TEBBUTT

Accidents and Industrial Diseases

Any accident which causes loss of life, or disables a person for more than three days from earning full wages at the work at which he was employed, must be reported to the Factory Inspector. If the injury subsequently proves fatal, the death must be reported even though the injury has previously been reported. Notification must also be given concerning certain industrial diseases which may be contracted (lead, etc., poisoning and other scheduled diseases) and at the same time the Examining Surgeon must be notified.

Meal and Rest Intervals (Dangerous Trades)

During rest or meal intervals a person is not allowed to partake of food or drink where lead, arsenic or other poisonous substance is so used as to give rise to dust or fume. By Regulations also this obligation can be extended to any other process which is considered injurious to health. Grinding, glazing or polishing on a wheel, brass casting, type founding, dipping metal in *aqua-fortis* or other acid solution are scheduled processes under these Regulations. Furthermore, any person employed as in the foregoing must not remain in such a room during meal or rest intervals, although this prohibition does not apply to short intervals allowed in the course of continuous employment (*e.g.*, less than half an hour). This latter provision also applies to any process which gives rise to siliceous or asbestos dust (such processes to be prescribed by Regulations).

Lifting Heavy Weights.—A young person must not be employed to lift, carry or move any load so heavy as to be likely to cause injury to him; power is given by Regulations to lay down maximum weights and other conditions.

Lead Processes

Employment of young persons and women is prohibited at a furnace where the reduction or treatment of zinc or lead is carried on; the manufacture of solder or alloys containing more than 10 per cent. of lead; the manipulation, treatment or reduction of ashes containing lead, the desilvering of lead or the melting of scrap lead or zinc; the manufacture of any oxide, carbonate, sulphate, chromate, acetate, nitrate or silicate of lead. This prohibition extends to the cleaning of workrooms where any of the processes mentioned are carried on.

Use of Lead Compounds

No woman or young person must be employed in any process involving the use of lead compounds, if dust or fume is produced, or the employees are likely to be splashed with any lead compound, unless certain safeguards are provided. Efficient exhaust draft must be provided; medical examination of the employees must take place at intervals and a health record be kept. No food, drink or tobacco must be taken in any workroom in which the process is carried on, and no person must remain in such room during meal time. Protective clothing must be worn by employees (provided by employer); cloak room, mess room and washing accommodation must be provided, and the workrooms and all tools and appliances must be kept in a clean state.

Duties of Employees

A general provision now lays down that an employee must not wilfully interfere with, or mis-use, any means, appliance, convenience or other thing provided under this Act. The employee must use the means or appliance provided, and an employee must not wilfully and without reasonable cause do anything likely to endanger himself or others.

Penalties

The provisions concerning penalties have been simplified. Except in special cases, such as offences under the provisions concerning samples, piecework, disclosure of information, forging false entries and descriptions, sellers of new machinery, steam-boiler examinations and fire escapes, any non-compliance or contravention of the Act, Order or Regulation is now subject to a fine (on conviction) of anything up to £20, plus £5 for each day on which the contravention is continued after the conviction.

Where there is an offence committed under the illegal employment provisions, the fine can be imposed in respect of each employee illegally employed.

When anyone is killed or dies, or is injured in health because the employer has neglected to observe any provision of the Act or Regulations, he is liable to a fine not exceeding £100. The whole or any part of the fine may be applied for the benefit of the injured person or his family. The employer is not, however, liable under this section for injury to health unless the injury is caused directly by his neglect; nor is he liable to a fine if an information against him for not observing the provision or regulation to the breach of which the death or injury was attributable has been heard and dismissed before death or injury occurred.

Piecework

An employer must cause particulars of piecework wage rates to be known to the employees concerned, but, so far as those trades which are not of the textile group, the obligations only apply by Regulations. There are, however, Regulations which apply this provision to iron and steel foundries, and the mixing, casting and manufacture of brass.

Regulations, Notices, etc., Commencement and Postponement

An important provision of the Act should be well understood. Although the Act will ordinarily operate from July 1, 1938, all existing Regulations, Orders, Bylaws, etc., will continue to have effect after this date, the same as before. Any notices, forms, etc., displayed or delivered by the employer will have lawful effect likewise, *i.e.*, no new ones will ordinarily be required except that, as shown, a new certificate under the fire-escape provisions must be obtained.

It should be noted also that, as regards the Safety Provisions (see the JOURNAL for May 12 and 19), if the Home Secretary is satisfied that, by reason of substantial expenditure involved through the necessity of providing new, or altering existing, buildings or plant, or on account of other special difficulties it would be right, he may by Order (to apply either to factories generally or to any class or description of factory) postpone the coming into force of any particular requirement to any date he may think fit, but not later than January 1, 1940. But in these cases the Order may direct that the requirements of the former Acts will continue to apply in lieu of the postponed requirement of the new Act.

Conclusion

An important change is that all establishments coming within the Act are styled factories, instead of the two terms "factories" and "workshops" being used as formerly, which also were divided into textile or non-textile premises.

Broadly, the Act will apply where there is any manual work used in connection with a process, and where the employer has right of access to, or control of, the premises. The size of the concern has no bearing on inclusion, as premises where one person is employed by another are within the scheme. Not only the actual manufacture or making of any article (or part of any article) brings the establishment under the Acts, but such processes as the following—altering, repairing, ornamenting, finishing, cleaning or washing, or the breaking-up or demolition of any article or the adapting for sale of any article—are within the scope of the scheme. Moreover, in the Act there is special mention applying the Act to the business of sorting or packing articles, filling or washing containers, when incidental to the work of the premises, even though the general definition of the Act may cover these workplaces otherwise.

ADDENDUM

Notice is given in the "London Gazette" that, at the expiration of forty days, the Home Secretary proposes to make regulations under the Factories Act, 1937. They include:—

Sanitary accommodation regulations.

Operations at unfenced machinery regulations, specifying conditions under which some operations may be carried out at unfenced machinery.

Protection of eyes regulations.

Factory overtime.

Shifts of male young persons regulations, modifying, in the case of four-shift systems and in the case of certain works, the conditions in the Act subject to which male young persons over sixteen may be employed in shifts at night in some continuous processes.

Night work of male young persons regulations, relating to examinations by the examining surgeon of male young persons over sixteen as to fitness for employment in shifts at night.

Factories (intervals for women and young persons) regulations prescribing conditions subject to which the women and young persons employed in a factory need not be allowed the same intervals for meals or rest.

Notice is also given that the following Orders come into force on July 1:—

Local Authorities (Transfer of Enforcement) Order, the effect of which is that the factory inspectors, instead of the district councils, will enforce specified general health provisions.

Dangerous Machines (Training of Young Persons) Order.

White Cast Iron

(*Concluded from page* 442.)

of hardness well over 400 can be drilled if the proper drill be used; the author uses a "Saville Triumph Superb 1,000" ½-in. flat drill at very low speed and high feed pressure. With this drill in 400 Brinell iron three samples of about 15 grms. each can be drilled without resharpening, and this is easily touched up in a few seconds. Of course, no lubricant or cooling agent is permissible.

It is not proposed to deal with chemical analysis at length. Merely the methods which have been found most suitable will be mentioned.

Total Carbon.—Direct combustion with red-lead flux and suitable precautions against the SO_2 evolved reaching the absorption tubes; ascarite is the absorbent used.

Graphitic Carbon.—Direct combustion after separation on asbestos.

Silicon.—The nitro-sulphuric method is rapid and reliable and yields silicon only rarely requiring treatment with hydrofluoric acid.

Manganese.—The sodium bismuthate method is rapid and gives reliable results, provided that sufficient bismuthate is added in the preliminary oxidation.

Chromium.—Oxidation with permanganate and titration with ferrous ammonium sulphate and permanganate. With higher percentage of chromium, over 5 per cent., difficulty is experienced in dissolving the iron in acids, and a preliminary fusion in sodium peroxide is made, followed by titration as above.

Sulphur.—The evolution method is unsatisfactory, and the barium-sulphate method is to be preferred.

Phosphorus.—Lead molybdate method.

Transfers Suitable for Vitreous Enamelling and their Application

When Mr. P. S. Mecrate-Butcher presented his Paper bearing the above title to a meeting of the Institute of Vitreous Enamellers, held in Manchester, it gave rise to an interesting discussion. From it, it was established that transfers are more extensively used on cast iron than most of the Northern audience were aware.

The discussion was opened by the CHAIRMAN (Mr. W. H. Whittle), who said that the members were appreciative of the very interesting lecture. He thought the lecturer had been too apologetic. Most of them knew about the author's transfers. The reference to Eccles was in the early days of transfers, when a little trouble was experienced, as had been mentioned, with firing. The exact temperature at which it was suitable to fire had not been found, and, of course, enamel varied considerably. Drying had been referred to. The firm with which he (the speaker) was connected had used the Butcher transfers for quite a long time. The lecturer had not, unfortunately, brought any specimens with him to the meeting, but if he had done so, he could have shown some really wonderful designs. Any member who was not *au courant* with general transfers would be surprised at the multi-coloured designs produced.

Dust-Free Application

At his (the speaker's) works they had a separate room for putting the transfers on to avoid dust contamination. If there was a separate room available, the articles on which the transfers had been placed could be allowed to remain a little longer. In that case, they were dried out a little more before they were taken to the drying room. Care was taken to eliminate water bubbles, but the usual practice of drying the ordinary enamels in the biscuit stage was carried out; that was, to heat from the base, where possible. In that way many difficulties were overcome, because the metal heated up first, and, therefore, absorbed all the moisture which might be left. That could not be done with cylinders, in which case it was better to make certain the water was away.

An acid resistant glaze over the transfers would overcome the difficulty of acid resistance, although it might take away some of the usual brilliancy of the transfer.

Firing Temperatures

Dealing with sheet enamel, a soft enamel could vary anything up to 100 deg. C. Mr. Butcher had said that a white transfer could be fired at anything from 750 to 800 deg. C.

He, the speaker, knew of amounts of white being fired up to 880 deg. C., so that was quite a different enamel from that below 800 deg. C. which had been mentioned. In that case they could not, if they put hard ceramics on to the transfer, come up to their full brilliancy, if one was firing at the lower temperatures.

Referring to an automatic machine for mint sweets brought out by one firm, the chairman said thousands of transfers had been used on these and they were very tricky, being small multi-coloured transfers, but they had proved very successful. If one had the correct temperature for the transfers the percentage of rejects was very small. He advised members to send to the transfer makers a piece of the enamel, indicate at what temperature they were firing and leave the rest to the specialists. According to the firing temperature of 800 to 850 deg. C. the makers could give a softer or harder transfer. The result would be tested in the maker's laboratory and satisfactory results obtained.

Composition of Colour Bases

MR. A. K. WILLIAMS said he had inquired a short time ago whether it was possible to have white transfers. Mr. Butcher had already told them that it was very difficult to get sufficient opacity in a transfer. It was not exactly explained to him, and he did not know the nature of the material or the base upon which the colours were made. Of course, in an enamel itself, its base was glass, and he was under the impression that a ceramic transfer was more or less of the same nature, for the colours were coloured frits very finely powdered and dusted on to the paper. If that were so, and a white enamel was ground almost to infinity, dried out, and dusted on to the gum, he would have thought it possible to secure a white transfer. But, apparently, the medium was something quite different from that, and therefore such a process was impossible. He confirmed what Mr. Whittle had said. His own firm were habitually firing transfers at 850 deg. C., and the reason they did that was, as Mr. Whittle said, if they did not they would definitely disturb the white coat underneath.

White Transfers

The LECTURER said that with regard to the bases of the colours that were used he was going to say quite frankly that he, personally, did not know a great deal about that part of the business. It might sound extraordinary to tell them that, but it was correct. They were in the hands of the colour makers as to what colours they supplied. His firm continually asked for different samples of colours, and passed on information that they received from the enameller to the colour maker, and so experimented as they went along to find the best colour. He certainly did not think for a moment that the colour had a glass basis at all.

With regard to white transfers, one obtained white just in the same way as they did any other colours, namely, in powder form. But if they wanted a sufficient opacity to blank out the black enamel background, the only way that came to one's mind to do that was to print extra heavy medium so as to pick up more colour, but the more they did that, the more they induced the spitting which his firm had not been able to overcome. What was necessary, without a doubt, was a much more highly concentrated white. So far, they were just in the same position, but he could say that very shortly they would be able, he thought, to overcome that trouble.

A New Development

In the last month or two they had made experiments and gone right away, on that particular colour, from the ordinary process. He could not tell them much about it, because it was only experimental at the moment, but, he thought, perhaps, in about a month to two months' time they would be able to supply transfers in white that would be absolutely opaque. The only difference he could see in the type of transfer proposed, from the present type, would be that it would stand up rather on the enamel. He did not know whether that would be any detriment, but felt sure that perhaps, for the time being, enamellers would overlook that, because they would be only too pleased to get a white transfer.

Maximum Areas

MR. GRAY said that Mr. Butcher had mentioned 29 in. by 30 in. as the largest transfers he had ever come in contact with. Could he say what was the size of a solid patch of self-colour transfer he considered the most practical?

The LECTURER said he was afraid the dimensions were going to be considerably smaller. It usually depended upon the particular colour that they were going to use in a solid patch. For instance, he did not think they would experience any trouble with black, if it was of the size mentioned, but he would not like to suggest anything over about 6 in. square with any other colour. He did not know why it was, but as soon as they tried to print a solid patch of colour other than black, spitting was caused at once. He suggested to them that perhaps it was caused by the heavy amount of medium that was picked up.

Application to Cast Iron

MR. H. BRADLEY said the real reason why there were not so many questions asked the lecturer, was that most of those present were interested chiefly in cast iron work. Mr. Whittle was a notable exception. Most of them with whom he had made contact did not use ceramic transfers, but had employed the water slide, and that had been as much as they really needed up to the present time on cast iron; simply to label the goods and not from a decorative point of view.

There might come a time when more transfers would be used on the cast iron goods. The firm with which he was associated had fired one or two samples, and these had been fired on cast iron with fair success. He noticed that the lecturer did not specifically mention their use for cast iron. As far as he could remember, certainly, it would not stand very many minutes in the firing ovens without losing its colour, or sinking into the enamels that were on the cast iron. He would like the lecturer to give an approximate idea of how long one should fire a ceramic transfer on cast iron with enamel that they were firing somewhere in the region of 750 deg. C.

Industrial Uses

The LECTURER said it was rather interesting to hear Mr. Bradley mention the subject of cast iron, and transfers for fixing to it. He could only say that his firm were supplying a considerable quantity of transfers for cast iron.

MR. BRADLEY: For name plates?

The LECTURER replied that they were also supplied for trade names on scales, for petrol pump wordings, lettering on cast iron in black, and green, and, of course, in gold. It was rather a difficult question for him to answer about the exact time and temperature, but he could only tell them what he had seen in other shops. What he had noticed was that usually—he was dealing now with single colour productions, such as black, green, gold, any one colour—that they

fired at a temperature of 750 deg. C. and for a period of about 15 min. It had always been a sort of mystery to him how well the transfer withstood the process. One talked about sinking in, or distortion of colour. When he gave them those facts, he could say that the results he had seen were perfect. In the case of one particular shop with which he was acquainted, the firm had maintained a very high standard of efficiency; in fact, he had always thought it was too high a standard maintained for the use of transfers on enamel, but they had had no trouble at all. The one particular shop he had in mind fired for 15 min. They did not use a solid patch of colour. He was talking about open lettering —plain lettering—in either green, black, or in a single colour or open design work. His brother had made a note to the effect that the results depended a great deal on the thickness of the iron. Well, of course, that was known, because with cast iron they sometimes got a very great thickness in one part, and very often just where the transfers had to be fixed. If there was any information at any time which he could give on that subject, or transfers, he would be only too pleased to do so.

MR. WALKER thanked Mr. Butcher for explaining what was going on in regard to transfers in cast iron. The knowledge of a few present that evening with regard to transfers upon cast iron was rather limited.

Acid-Proof Transfers

The LECTURER expressed thanks for the information that he had received with regard to acid resistance. It would help him very much in the future. As far as was known up to the present, the onus would be on the enameller. He might say that, with black, it was practically acid proof, meaning the actual black colour used by his firm. Mr. Whittle's information with regard to firing would help them a great deal in being able to give the information to the trade in general.

Destructible Transfer

MR. GRAY said that on one occasion it was found with the transfers of a certain firm (not the lecturer's) that the colouring on the transfer rubbed off after firing, especially if it were moistened. It might be a trouble due to faulty application. Had Mr. Butcher experienced that trouble, and, if so, was it due to faulty application, or to the colouring used, or the general quality of the transfer?

The LECTURER replied that, as a matter of fact, a long time ago they did experience that trouble. He felt perhaps there were more experienced people—that was, the colour makers—who could answer the question. A particular firm had trouble with transfers in green which his own firm supplied. This green did, as suggested by the questioner, wipe away, particularly if it was moistened at all. This was a complete mystery to his firm, who had supplied that same colour to a dozen other firms without any complaint whatever. He had several interviews with the customer, and endeavoured unsuccessfully to determine the cause of the trouble. Eventually, the customer admitted that the trouble was due to the enamel they were using. They changed the enamel, and had not had any more trouble.

Vote of Thanks

MR. W. H. WHITTLE proposed, and MR. H. BRADLEY seconded, that a hearty vote of thanks be accorded to the lecturer for his interesting communication.

The vote of thanks was carried unanimously

Moulding and Preparation of Castings for Enamelling*

By R. B. SCHAAL

Enamel has a very appreciable thickness, and clearances and tolerances need to be worked out carefully to ensure accurate fit, especially where two enamelled surfaces or edges are to be fitted together. In fact wherever possible, direct enamel to enamel contact should be avoided, or these joints shimmed with soft metal strip. Stresses introduced by assembling imperfectly fitting enamelled parts may cause immediate damage in mounting or parts may fail prematurely in service. Enamel, while it will take a surprising amount of abuse or rough treatment, still is by nature similar to glass, and needs to be handled and considered with this fact in mind.

Accuracy in the manufacture of cast-iron parts for enamelling is promoted by the use of accurately-made aluminium match plates, with the gates and runners cast as an integral part of the pattern. This practice usually affords the best results from the production point of view, and is a valuable aid in obtaining accuracy and interchangeability of parts.

Flat Surfaces

One of the very hardest types of light casting to mould successfully is a large perfectly flat surface. Enamel defects and blemishes become very prominent on such surfaces and, therefore, they are most difficult to enamel successfully. In view of the decided trend in design towards flat or modernistic lines in range design, it is desirable that these surfaces be relieved or broken up wherever possible. The clever designer can do this without detriment to the general effect, and such forethought will be repaid many times in production gains, freedom from defects and reduced costs.

Warping and Buckling

In this connection, the designer familiar with enamelling requirements will realise that enamelling itself is to the castings a form of heat-treatment, and he will use particular care to see that the castings are so turned out that they will not warp or buckle in the enamelling furnace. In this he will receive much aid by close co-operation with his foundry superintendent and pattern maker. In addition to the mounting and assembling difficulties introduced by warping or buckling, these two phenomena are the cause of much direct rejection of castings in the enamel shop.

When the casting buckles from the sudden heat of introduction to the enamelling furnace, the dry enamel film may crack open. Usually, such cracks partially fuse together but are visible as depressed lines after firing. These depressed lines are called hairlines by the enameller. If all the buckling tendency is removed in the first fire, a second coat may cover the lines, but if the buckling is repeated (it usually is) the fired first coat, as well as the dry film of the second coat, may crack and deep lines, possibly blistered, result, with consequent rejection of the enamelled part.

When areas of the casting are grained in a contrasting colour, even faint hairlines will show through the grain. Slow heating, such as that normal to the operation of the continuous enamelling furnace, usually helps to keep down this hairlining tendency.

Warping and buckling, or their absence, are dependent largely upon the casting section and shape. It seems to be well demonstrated that castings which heat uniformly buckle the least. Here, again, the designer has a problem, the solution of which calls for both considerable knowledge and much thought. Even heating above all calls for uniform casting section. A heavier section always will arrive at a given temperature more slowly than a light one adjacent to it, consequently much effort is directed to producing a pattern in which all sections are equally thick. Edges seem to heat faster than flat surfaces, so they may be designed to compensate for this tendency. Heavy lugs and ribs are avoided when possible.

Parting Lines

The location of a parting line can influence enamelling results materially. For example, in Fig. 1, castings A and B are flanged. The difference between them seems to be only a matter of a parting line, yet casting A will probably hairline where B will not.

Another important enamelling consideration is illustrated by an examination of Fig. 1, by considering the outsides of the flanges to be enamelled. Where the parting line occurs in casting A, or where the top of the flange meets the face of the casting, there is a sharp edge. When fused, enamel tends toward a spherical or cylindrical shape, consequently this edge tends to come through the enamel coating as shown in Fig. 2. Either a dark line or bare iron probably results. Casting A of Fig. 2 shows the behaviour of enamel over the corresponding point of casting A, Fig. 1.

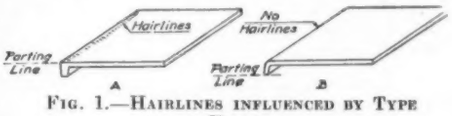


FIG. 1.—HAIRLINES INFLUENCED BY TYPE OF FLANGE.

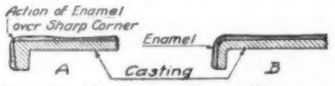


FIG. 2.—EFFECT OF SHARP EDGES.

Uniform Casting Section

A further important consideration is illustrated in Fig. 3, which also helps again to illustrate the advantage of uniform casting section. Considering what happens to the metal when it solidifies in the mould at point X of casting E, Fig. 3 shows that this point, representing a heavier section than the corresponding point Y of casting F, will be slower to solidify than the remainder of the section. This means that the iron in the point of surface above X will be at least looser grained than in the surface over the remainder of the section. Loose grain or "soft" areas in the casting surface are more reactive with enamel than the adjacent closer-grained surface, and tend to boil and blister more, given the same enamelling treatment.

FIG. 3.—SHRINKAGE BROUGHT ABOUT BY LOOSE-GRAINED AREAS.

In addition to the increased boiling and blistering hazard at this point, there also may be shrinkage. If this heavier section is fed (as is usual) through the lighter section adjacent, the feeding may be cut off before the flange solidifies completely. This may result in a shrinkage line, the depth of a "rat tail," along the entire top of the casting over the flange, which will certainly cause rejection after enamelling, even if no boiling or blistering has occurred.

The desirable features in design of enamelling castings then may be stated as follow:—(1) Careful attention to clearance and tolerances; (2) accuracy of the pattern to ensure proper fit upon assembling; (3) reproduction of pattern accuracy in each casting; (4) freedom from unusual warping and buckling on heating; (5) uniform section; (6) care in selection of parting lines; (7) breaking up of large flat surfaces; and (8) elimination of sharp edges.

* Extract from a Paper read at the Annual Convention of the American Foundrymen's Association at Cleveland last month.

Relation of Microstructure to the Enamelling Properties of Cast Iron*

By G. H. SPENCER-STRONG

Four major defects encountered in the enamelling of cast iron may be caused either in part or entirely by the iron:—(1) Blistering—the disruption of the enamel by the formation of gas bubbles at the enamel-iron interface and the passage of these bubbles through the enamel to the surface; (2) failure of the enamel to adhere properly to the iron; (3) warping of the casting, either before or during the enamelling process, and (4) hairlining—the formation of fine cracks in the enamel, due to strains set up either during the enamelling operation or in service.

Study of Microstructure

In the consideration of enamelling iron metallographically, often it is found that foreign materials and structures in the iron are as important as the basic components. In a great many of the past considerations of the enamelability of cast iron, interest has been centred chiefly upon the composition of the iron. A great deal of attention has been given to what goes into the cupola, but not so much attention has been paid to what comes out, from the metallographic standpoint. Thus, the temperature of the iron, the size and design of the casting, the moulding practice, length of time in the sand, and, finally, since the enamelling operation is an annealing or normalising treatment, the temperature and time of enamelling fire all will affect the microstructure of the casting and its enamelling properties. The study of the relation of microstructure to the enamelling properties of cast iron should prove of considerable value in solving the joint problems, and also may prove of interest to metallurgists working on the mechanism of the graphitisation of cast iron.

Blistering arises from the generation of gas in or at the surface of the iron after the enamel has begun to fuse over and results in the destruction of the continuity of the surface of the enamel. Sizes of blisters and their advancement will vary rather widely. Blisters may range from the size of a pinhead to craters about as large as a sixpence.

If the blister has broken and partially healed, pits in the enamel are evident, so the pitting also may be considered as a type of blistering. The gases giving rise to blistering defects have been identified by Krynitsky and Harrison as the oxides of carbon, *i.e.*, carbon monoxide and carbon dioxide, indicating their source as either the graphite and temper-carbon in the iron or the combined carbon therein.

Iron Oxide

Obviously, a source of oxygen is necessary for reaction with the carbon. Krynitsky and Harrison state that the oxygen is derived almost entirely from the air. Poste offers the oxide of iron either at the surface, or, in some cases, within the metal as an added source. Angus feels that blistering is due very largely to the ability of an iron surface to absorb oxygen and iron oxide, and that this absorption may take place during the cooling of a mould, during annealing before shot-blasting, or during the early stages of enamelling. He states the belief that the ability of irons to absorb oxygen and iron oxide differs and causes the variation in blistering tendencies noticed. Gaseous evolution, due to the presence of iron oxide, has been described by Moldenke. Wm. Bogenschutz has maintained that iron oxide is one of the chief sources of blistering defects.

Evidence at hand would indicate that iron oxide may or may not cause blistering, for a section through a blistering casting has shown the various areas on the surface to be spongy, with rather large iron-oxide formations. In each case, blistering occurred over these areas.

A second case showed a somewhat similar formation of oxide from which no blistering resulted. There was a rather heavy formation of iron oxide between the enamel and the iron. Poste shows photomicrographs which are cited as examples of blistering due to iron oxide. In some of these cases, the iron appears to have been burned; that is, there is an oxidation along the boundaries of the ferrite grains. Other evidence has appeared in which iron oxide, scattered through the body of the iron in the form of crystals of magnetite, appears to have had a connection with blistering phenomena. It is quite possible, and probably true, that the degree of oxidation of the iron oxide and its form in the iron may be factors in the blistering problem.

Blowholes and Slag or Dirt Inclusions

Most authorities agree that blowholes and slag or dirt play an important part in causing defects. Their presence is objectionable and indicates improper foundry practice. Angus states that he has conducted numerous experiments in the porosity of enamelling iron by simulating blowholes artificially. However, it does not seem reasonable to believe that a drill hole, although tightly capped, will show the same characteristics as a natural blowhole in the iron, since some blowholes contain gases, while others appear to contain slag and iron oxide. Certainly the pressure conditions inside a blowhole would be difficult to simulate. The fact remains that the presence of blowholes in blistering iron is more common than in non-blistering iron. At times it would appear that small blowholes may cause more trouble than large ones.

Chill

Most authorities agree that micro-chill structure in cast iron for enamelling is highly detrimental, since it may be the cause of blistering, poor adherence, warping and excessive shrinkage in the castings. The defect often is encountered in small castings in very thin sections, such as stove grates. An interesting example of the effect of chill was provided by a stove grate, for about one-fourth of the area of the grate was blistered but the remainder enamelled perfectly. Microsections of the blistering and non-blistering areas of this grate indicated a pronounced chill structure in the blistering area.

While there is complete accord over the undesirability of macro-chill structures in enamelling iron, there is one form of chill, the importance of which is somewhat controversial. Krynitsky and Harrison state that the chief cause of blistering is micro-chill—a thin chilled layer or skin at the surface of the castings which, they report, is extremely difficult to remove by ordinary sand-blasting methods. Poste agrees in part with this contention that some factor at the surface of the iron may be the cause of blisters, in view of the fact that he has been able to improve many blistering irons by removal of the surface layer. He further states that apparently there are other factors which enter into the problem.

Angus feels that the chief evidence of micro-chill appears to be circumstantial only and maintains that microscopic examination does not appear to uphold the presence of any special form of cementite in the surface layers. In place of the micro-chill theory, he substitutes his absorbed oxygen and iron oxide theory. While this might be true in the case of oxygen and iron oxide absorbed in the mould during cooling, it does not explain the experiments of Krynitsky and Harrison and Poste who claim to have eliminated blistering in some irons by mechanically removing a few thousandths of an inch of the surface of the iron.

While the writer occasionally has encountered micro-chill in commercial castings, it has not been noted in anywhere near the majority of the blistering iron examined. He has, however, noted it quite often in the smaller test castings.

Free Carbon o Graphite

Most investigators maintain that a coarse graphite structure is more apt to be present in a blistering iron than a finer type of graphite. Some writers also hold specular carbon to be blister-producing. Results of the study of a number of blistering and non-blistering commercial irons would indicate that coarser graphite does appear more often in blistering iron than finer graphite, that the presence of larger amounts of amorphous carbon in conjunction with coarse graphite is more often found in blistering than non-blistering iron, and that the combination of very coarse and very fine graphite, especially when the fine graphite is located at the surface of the casting, often is found in blistering iron.

Non-blistering irons usually show a finer and more uniform graphite structure than blistering irons. Very fine graphite structure, due to chill, may be expected where blistering is due to such chills. Angus feels that graphite formation is a major factor in the blistering problem and reports that a fine graphite structure is more desirable than a coarse graphite structure. Where there is a combination of coarse graphite with fine graphite at the surface of a blistering casting, and the graphite has broken down in a rosette structure, the surface of the iron is spongy with fine graphite and amorphous carbon.

Combined Carbon

The presence of combined carbon as cementite in enamelling iron admittedly is undesirable. Such iron practically always develops blisters. The combined carbon as pearlite, present in enamelling iron, presents one of the most interesting phases of microstructure study of enamelling irons. Since the enamel operation represents an annealing or decarburising process, the pearlite usually will be either partially or entirely broken down during the enamelling treatment.

The rate of breakdown of the pearlite constitutes a vital part in the question of enamelling properties. The problem is complex, since the whole thermal and chemical history of the iron is involved. Most investigators have agreed that an iron in which all the combined carbon breaks down during enamelling operations is superior to one in which decarburisation only is partial. For this reason, a high-silicon iron is specified. The reasoning is correct so far as it goes, but does not entirely solve the problem, since thermal history and section-weight or heat capacity of the iron are not considered. Thus, it is quite possible for iron to decarburise completely, but if the major portion of the process takes place after the enamel has begun to fuse, there may be trouble.

Poste has shown that the carbon dioxide gas given off in the annealing of blistering iron usually is considerably less than that given off in the annealing of non-blistering iron, indicating the delayed carburisation may be a factor. Some irons decarburise so slowly at enamelling temperatures that no difficulty is encountered in enamelling them. Some irons will decarburise at the surface only, while others will decarburise partially more or less uniformly through the casting. Occasionally, an iron is encountered in which the centre of the casting will decarburise while the surface does not appear to do so.

Cast-iron enamels are fused at temperatures ranging from 677 to 760 deg. C. The firing time

* Extract from a Paper read at the Annual Convention of the American Foundrymen's Association at Cleveland last month.

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usually is approximately 20 min., although in extreme cases the time may be as short as 15 min. or as long as 30 to 40 min. Since these temperatures include the eutectoid temperature and since some metallurgists claim decarburisation progresses very slowly below 800 deg. C., the mechanism of the decarburisation of enamelling iron should be of interest, and it is believed that careful and comprehensive studies of the subject should prove of value to both founders and enamellers.

The relation between enamelling properties, decarburisation rate and enamelling temperatures is illustrated clearly in the case of an enamelling iron recently studied by the author. As is the case with many similar problems, the thermal and foundry history of the iron is not available. The casting, a moderately-sized stove top, was broken so that the sections were relative in size and proximity to the gates. Sections were made at various locations to give the structure at the gate, farthest from the gate and at the thinnest and heaviest sections, prior to enamelling. The casting was then enamelled with three enamels maturing respectively at 700, 730, and 760 deg. C. The 700 deg C. enamel blistered over both heavy and thin sections—the blistering being more pronounced over the heavy sections. The pieces enamelled at the higher temperatures did not blister.

Sections of the unenamelled iron show a rosette graphite pattern, the rosettes of graphite and ferrite being surrounded with pearlite, ranging in structure from coarse lamellar pearlite over the thin sections to both coarse pearlite and fine sorbito-pearlite over the heavy sections. Blistering sections showed residual pearlite in a cell-like structure over the heavy sections and as lamellar pearlite in the thinner section. After enamelling, the non-blistering sections showed complete breakdown and loss of combined carbon.

The effect of the structure of the pearlite upon blistering has not been commented upon widely in the literature. Available data shows a tendency for greater blistering with very heavy lamellar pearlite than with finer sorbito-pearlite. This is probably to be expected, since the finer pearlite would present the greater surface area.

Available data would indicate that the pearlite structure of iron of a given composition depends chiefly upon the thermal history of the casting. Thus, when three sets of identical castings were poured together and one set was removed from the sand while very hot, in fact, as soon as the castings could be handled without distortion —a second was shaken out as soon as the core in the riser was black and the third set allowed to cool in the sand, it was found that, after enamelling, the first set blistered while the other two did not. Chemical analysis shows that the combined carbon in set I was only half removed in the enamelling operation, while in sets II and III the iron was practically completely decarburised. Micrographic studies indicated that coarse graphite and coarse lamellar pearlite were obtained by rapid cooling, while fine graphite and pearlite structures resulted from slower cooling. The results show the possibility that slower cooling possibly might eliminate blistering in some types of iron.

The effect of pouring temperatures upon the microstructure of metals is well known. As Bolton so aptly states " Proper pouring temperature ranges have been worked out for a number of metals and it is quite common, in non-ferrous foundries especially, to see pouring temperatures controlled pyrometrically. In some cases, this is done also in steel foundries and perhaps least often in iron foundries." It might be added that practically no stove plate foundries have much of an idea as to what the temperature of the iron they are working really is.

No data are available as to the effect of pouring temperatures on the enamelling properties of cast iron with the exception of the fact that excessively hot irons are to be avoided because of burned-in sand and the opinion expressed by several founders known to produce high-grade enamelling iron to the effect that hot iron will produce better enamelling iron than colder iron.

A final factor in the relation of pearlite to blistering is found in the variation of section weight over the casting. Marked variations in structure often give rise to blistering due to the fact that the mass of metal in the heavy sections retards decarburisation and also because of the gases formed in the heavy sections after the enamel has fused. Thus, if a piece showing wide variation in section be enamelled to give the best job on the thin section, if the iron has blistering tendencies, blisters will show up over the heavy sections, while if the piece is fired to get good results over the heavy sections, the thin sections will be overfired. The problem resolves itself into a matter of so designing the casting to secure as uniform a section as possible.

The microstructure of residual pearlite found in enamelled cast irons showing blistering varies considerably. Thus, one iron, showing initially a coarse lamellar pearlite, will show, after enamelling, a fine sorbito-pearlite structure while another may retain its lamellar structure and merely show a diminution of amount of pearlite remaining.

General Comments on Blistering

While the effects of microstructure upon blistering defects have been considered from the standpoint of the individual components which go to make up the microstructure, it would appear reasonable to believe that many, if not most, of the troubles encountered are due to a combination of improper factors rather than to any single one. For example, some irons containing considerable iron oxide or slag will enamel satisfactorily, while others which appear to contain less will, due to the conditions of the other components, blister badly.

It is to be noted that the above considerations have not included steadite. Steadite always is present in enamelling irons. The size and shape of the particles vary from fine, widely disseminated particles to large concentrations, depending upon composition and thermal history. No mention is made in the literature connecting steadite with the blistering phenomena. Boyles failed to find any connection between phosphorus and graphitisation, and most other authorities agree that the chief effect is the depression of the freezing point of the iron. The examination of many blistering enamelling irons fails to indicate any connection between the steadite and the enamelling defect as regards blistering.

Relation of Microstructure to Adherence

Adherence defects in enamelled cast iron are not as prevalent as blistering defects, nor are they as closely connected with the composition and microstructure of the iron. Usually, improper design is a major cause and often improper furnace atmosphere during the enamelling will be a factor. In one case, it was found that, with a slow decarburising iron which blistered under the application of cover-coat enamels direct on the iron, a coating of temper carbon was formed at the interface when a ground-coat enamel was used with the resulting poor adherence. While the defect was due primarily to a leaky furnace muffle, the defects were found to be more prevalent on certain types of castings, indicating that the microstructure of the iron could have been an accessory factor. In one other case, a very heavy steadite structure at the surface caused poor adherence. A number of other cases of poor adherence has been shown to be the result of a chill condition, the chill being in some cases micro- but more often macro-chill.

Relation of Microstructure to Warping

The only cause of warping, of interest from the metallographer's standpoint, is chill. Since moulding practice and design play a much more prominent part in the control of this defect, the metallographer is seldom, if ever, called upon to deal with it. The fourth major cast-iron defect due to iron, hairlining, is the result of strain set up due to the improper design, and is not to be blamed upon microstructural factors.

American Notes

(FROM A SPECIAL CORRESPONDENT.)

Large Cast-Steel Turbine Component

The illustration below shows an erecting-shop view of an assembled cast-steel speed ring forming part of one of the two 55,000-h.p. hydraulic turbines constructed by the Allis-Chalmers Mfg. Company's Milwaukee plant for the Pickwick Landing Project of the Tennessee Valley Authority. The photograph, which shows the

STEEL SPEED RING FOR LARGE TURBINE, CAST IN SIX SECTIONS AND ASSEMBLED, BEING MACHINED (ALLIS-CHALMERS MANUFACTURING COMPANY).

partially-machined bottom flanges, was taken just as this piece was being turned over for machining the top flanges. The turbine part was cast in six sections, and has an outside diameter of 37 ft. 4 in., an overall height of 14 ft. 6 in., and a weight of 110 tons. The two turbines, forming the initial installation of six units planned for the Dam, are the largest propeller-type hydraulic turbines in the United States.

Iron and Steel Output

The British Iron and Steel Federation announce that there were 111 furnaces in blast at the end of April compared with 118 furnaces at the end of March, eight furnaces having ceased operations during the month, and one having resumed production. The production of pig-iron totalled 661,000 tons, and included 145,400 tons of hematite, 380,500 tons of basic, 105,400 tons of foundry, and 17,000 tons of forge pig-iron. The production of steel ingots and castings amounted to 938,600 tons. The Federation observe that the second quarter in steel production began with some further relaxation from the peak conditions which developed last year. Whereas, in 1937, practically every producer operated throughout Easter, this year advantage was generally taken of the holiday, and this extended to a full week in the case of a number of plants. Allowing for such special stoppages, the average effective daily rate of steel production, taking the industry as a whole, amounted to approximately 39,000 tons in April, compared with 41,500 tons in April, 1937.

HOLWELL IRON

in Machine-cast Pigs

SPECIFICATION:

Weight	-	-	60-70 lbs.
Length	-	-	19½ inches.
Width	-	-	8½ inches.
Thickness	-	-	3¾ inches.

The chemical analysis and well-known physical properties of Holwell Iron remain unaltered.

Holwell Iron is a clean-melting, fluid Pig Iron which produces castings especially suitable for vitreous enamelling.

The Stanton Company have many years' experience of metallurgical problems. This experience is at your disposal on any problem in connection with the Foundry.

The Stanton Ironworks Company Limited, Near Nottingham

The Largest Producers of Foundry Pig Iron (for Sale) in Great Britain

The Week's News in Brief

Trade Talk

CRAVEN BROS. (MANCHESTER), LIMITED, have decided to put in hand immediately further extensions to the erecting bays.

DORMAN, LONG & COMPANY, LIMITED, Middlesbrough, have denied a rumour that the South Bank blast furnaces are to be closed.

OWING TO REDUCED DEMAND for pig-iron, the Renishaw Iron Company, Limited, Renishaw, have closed down their No. 1 furnace. At the beginning of February the firm blew out the No. 2 furnace for the same reason.

THE FOUNDERS' COMPANY held their annual dinner at Carpenters' Hall, London, on May 24. The toast of the "Worshipful Company of Founders, the Master and Wardens" was proposed by Mr. J. G. Pearce (director of the British Cast Iron Research Association).

A TRADE DELEGATION, organised by the London Chamber of Commerce, will leave Hull on June 4 for a tour of the principal business centres of Finland. Export trades covered by the delegation include engineering plant and supplies, hardware, cutlery and edge tools.

THE FREE TRIP to Great Britain, including a visit to the Empire Exhibition, offered by R. A. Lister & Company, Limited, to overseas agents and customers for the best advertisement for their new Listard (van der Horst) process, has been won by Miss Zeta Burgess, of Johannesburg, South Africa.

THE HOME SECRETARY has made an order (under Section 45 of the Factories Act, 1937) in which the minimum first-aid appliances are set out for various categories of factories. The order is printed as "Statutory Rules and Orders, 1938, No. 406—Factories," and costs a penny at H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2.

FERRANTI, LIMITED, have recently entered into arrangements with Wild-Barfield Electric Furnaces, Limited, Elecfurn Works, Holloway, and their associated company, G.W.B. Electric Furnaces, Limited, whereby these two companies have the sole right for the supply of Ferranti moving-coil voltage regulators when fitted with the Ferranti temperature voltage relay control for furnace work. The combination of these equipments enables extremely close control of temperatures to be maintained

WITH REGARD to the statement made by the chairman of Stewarts and Lloyds, Limited, at the annual general meeting on May 17, to the effect that it had always been the custom to hold in the treasury a certain amount of authorised share capital available for issue by the board, if a desirable opportunity should arise, for the purchase of some business concerned with the trade, for an exchange of shares with an allied company or for other purposes of the business, the directors state that they have in view no scheme which would call for a large issue of capital. Neither is it their intention to offer any capital to the shareholders for the purpose of adjusting the ratio between nominal capital and earning capacity, but they feel strongly that the treasury, which is now empty, should be replenished for the reasons given, and meetings of the company, and of the various classes of shareholders, will shortly be called to authorise the creation of additional capital.

AN OLD-ESTABLISHED WALSALL WORKS has recently changed hands by the sale of Samuel Russell & Company, Limited, malleable ironfounders, Northcote Street, to Kirk & Company (Tubes), Limited, Fulford Street, London, S.E.16. Mr. A. E. Hurst, who has been the managing director since the death of his brother, Mr. C. F. Hurst, in 1931, remains on the board but in a consultant capacity only, and to that extent will continue the family connection with the business that his father, Mr. Edwin Hurst, joined in 1872. In 1898 the two brothers, Messrs. C. F. and A. E. Hurst, became associated in the business, and a private company was formed, the present works being built a few years later. Mr. A. E. Hurst has been the chairman of the Malleable Ironfounders' Association for a long period, and as far back as 1920 he was presented with an illuminated address and silver in recognition of his services, particularly during the war.

Obituary

MR. ARTHUR CHAPMAN, chairman of Catton & Company, Limited, Yorkshire Steel Foundry, Hunslet, Leeds, died in a Leeds nursing home after a short illness, in his 76th year. He was one of the early pioneers in the manufacture of steel castings, commencing his career as a boy in 1875 making clay crucibles. Mr. Chapman had a wide circle of friends in the engineering industry of this country.

MR. JAMES DYAL, who had been in the service of Thos. W. Ward, Limited, Sheffield, for 54 years and a local director for 19 years, died on May 24. Mr. Dyal was well-known in industrial circles in all parts of the country, especially in the iron, steel, and allied trades. Until a serious illness sent him into semi-retirement three years ago he travelled many thousands of miles yearly both in this country and abroad in connection with the dismantling and development of industrial properties. His career commenced when the scrap trade was mostly local and he saw the dismantling activities of Thos. W. Ward, Limited, grow to their present magnitude.

THE DEATH occurred at Torquay on May 27 of Dr. William Stroud, chairman of the famous firm of scientific instrument makers, Barr & Stroud, Limited, Anniesland, Glasgow. Dr. Stroud, who was 79 years old, was a native of Yorkshire, and before entering industry was Professor of Physics at Leeds University. His friendship with the late Dr. Barr, his partner, began in 1884, when the latter was appointed to the chair of engineering at Leeds. Five years later Dr. Stroud was appointed Regius Professor of Engineering at Glasgow University, a position he occupied for 24 years, resigning in 1913.

MR. JAMES HOWDEN HUME, who has died in a London nursing home, was chairman of James Howden & Company, Limited, Glasgow, which was founded by his uncle, James Howden, in 1854. Born in Glasgow in 1866, he was educated at the High School and Technical College, and became chairman of the firm on the death of his uncle in 1913. Mr. Hume was a Past-President of the Institution of Engineers and Shipbuilders in Scotland, a member of the Institution of Civil Engineers, the Institution of Naval Architects, and the Institute of Marine Engineers. He was also a Burgess of the City of Glasgow and a Freeman of the City of London.

WITH DEEPEST REGRET we announce the death of Dr. J. W. Mellor, F.R.S. He died last Tuesday, but at his express request no notice was published until after the cremation. "Uncle Joe," as he was affectionately called by his friends, was born in Huddersfield, was educated in New Zealand, and received his technical training at what is now the University of Manchester, where he obtained his degree of D.Sc. His long and distinguished career as Principal of the North Staffordshire Technical College brought him into contact with three related industries, ceramics, refractories and vitreous enamelling, and in all three he was the recognised leader of thought. For the first he acted as honorary secretary of the Ceramic Society; for the second he was the director of the Refractories Research Association, and for the third he became the first President of the Institute of Vitreous Enamellers. His great abilities as a scientist were recognised in 1927 by his election as a Fellow of the Royal Society, whilst his work for the technical societies earned for him the award of the C.B.E. in the Coronation Honours. He wrote what is probably the most voluminous work on chemistry ever published, and it is the standard work on the subject. Entitled "Comprehensive Treatise on Inorganic and Theoretical Chemistry," it is contained in sixteen volumes. He was a cartoonist of no mean order, and he delighted his many friends by gifts of his whimsical book, "Uncle Joe's Nonsense." A second hobby was chess, of which game he was one of the best exponents in the country. His passing at the age of 68 leaves a gap in the scientific world which there is but little prospect of ever being filled. He had a genius for making friends with both young and old, and his contribution to technical literature was truly prodigious.

Light Castings Industry Adopts Holidays with Pay

Foundry workers in the light castings industry are to have holidays with pay, as a result of an agreement reached between the National Light Castings Ironfounders' Federation and the Joint Committee of the Light Metal Trades. Time workers and piece workers, male and female, are included in the terms of the agreement, irrespective of age, but the scheme will not apply in cases where provision for payment for holidays is already in operation.

The details of the scheme were announced at Falkirk on May 27 by the general secretary of the Ironfounding Workers' Association. The scheme is to operate in respect of work done from the commencement of a period 8 months prior to the annual holidays of 1938, and payment is to be made up to a date two weeks before the start of the holidays. The allowance to be granted is a sum equivalent to one-fiftieth each week of the appropriate day-time rate to each class, plus the war advances and bonuses at the time payable to time workers, subject to a maximum number of hours of 47 in any one week. Merit or ability increments are to be included.

Where less than 47 hrs.' work has been performed in any one week, the sum to be credited will be the appropriate payment of the full week's allowance. This will also apply when the works are temporarily on short time. In the case of piece workers, whose time is not subject to check, but where for the purpose of applying the war advances and bonuses it is assumed that they have completed 47 hrs., the full week's allowance will be credited.

Overtime hours worked shall not be taken into the computation to arrive at the amount due, except to such extent as may be necessary to make up the time worked in any week to the maximum of 47 hrs. Casual labour employed in Federation shops under light castings rates and conditions will be entitled to holiday allowances. In the case of rammers-up, who are paid by the men engaging them in the shop, the amount paid to them will be ascertained by the firm and the holiday allowance will be based thereon.

Where there is no agreed rate for workers, such as cupola men, the allowance will be based on the rates appearing in the firm's books for these classes. For workpeople employed in enamelling departments a scale of rates has been fixed on which holiday payments will be made.

Personal

MR. JOHN NEILL has been elected a director of Richardsons, Westgarth & Company, Limited.

DR. W. D. JONES has resigned his position as lecturer in metallurgy at the Sir John Cass Technical Institute, London, to devote his whole time to his growing practice as a consultant specialising in powder metallurgy.

DR. H. J. GOUGH, F.R.S., Superintendent of the Engineering Department of the National Physical Laboratory, has been appointed to the new post of Director of Scientific Research at the War Office. He assumed his new office yesterday.

PROF. R. H. FOWLER, O.B.E., M.A., F.R.S., at present Plummer Professor of Applied Mathematics in the University of Cambridge, has been appointed Director of the National Physical Laboratory, with effect as from October 1 next. Prof. Fowler will succeed Dr. W. H. Bragg, who has been elected to the Cavendish Professorship of Experimental Physics in the University of Cambridge.

Forthcoming Events

JUNE 21-24.

International Engineering Congress:—To be held at the Empire Exhibition, Bellahouston Park, Glasgow.

Institute of British Foundrymen

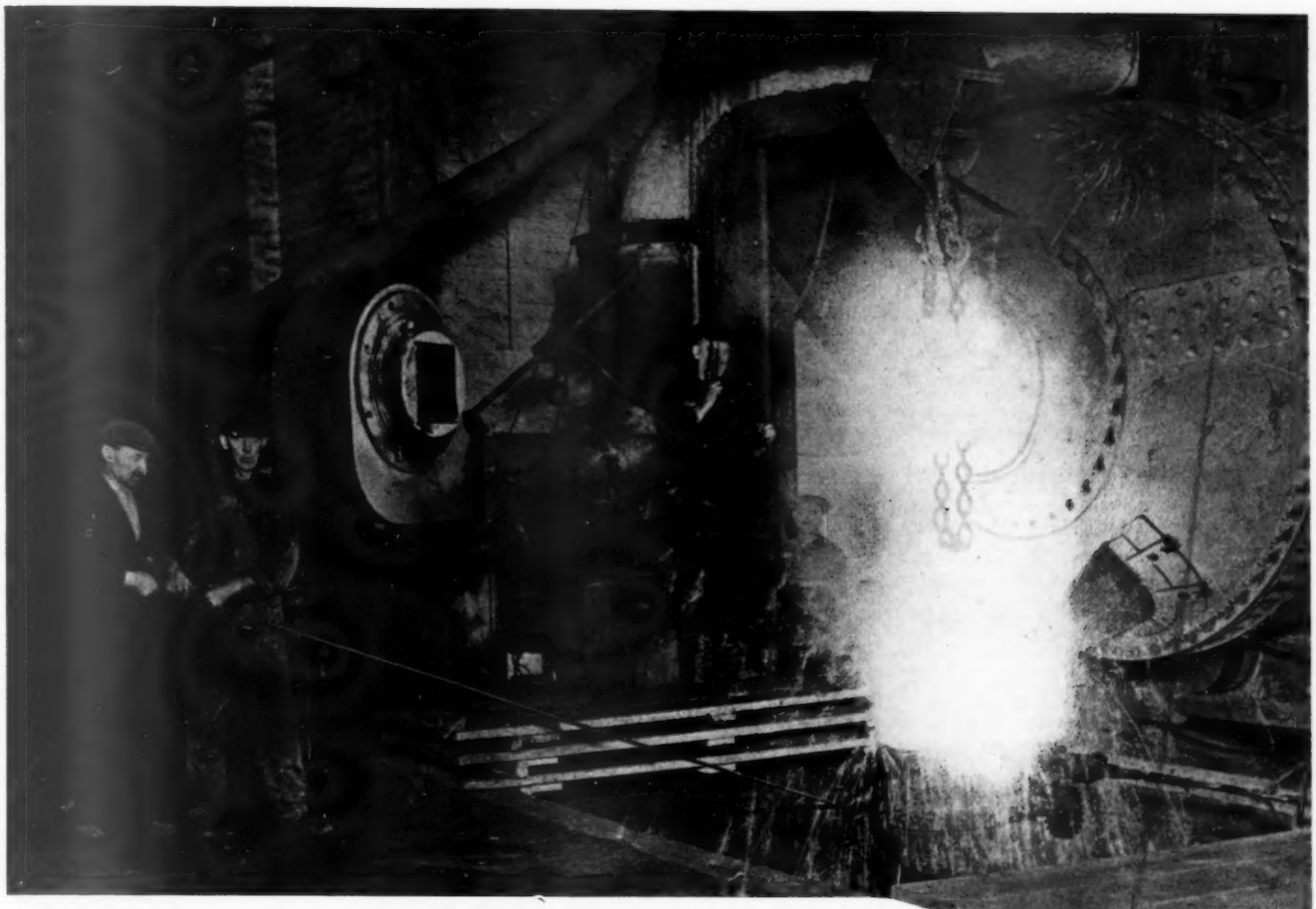
JUNE 14-17.

Thirty-fifth Annual Conference at Bradford.

The Institute of Vitreous Enamellers

JUNE 4-6.

Whitsun Conference at Glasgow.



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MANCHESTER OFFICE: 9, Albert Square. Telephone: Blackfriars 6130. Telegrams: "Genefax, Manchester." (Mr. S. G. Throssell).

MIDDLESBROUGH OFFICE: Halifax Bldgs., Exchange Place. Telephone: Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough." (Mr. J. A. Williams).

BIRMINGHAM OFFICE: 5, Lower Temple Street Telephone: Midland 6376. Telegrams: "Genefax, Birmingham." (Mr. G. Griffiths).

Raw Material Markets

The Foundry Pig-iron Producers' Association have announced that prices of foundry and forge irons will remain at their present levels until the end of the year. This decision of the makers will have been received with surprise by consumers, as only a week earlier the Association met and issued a statement to the effect that no change in quotations would be made on July 1; from this it was assumed in many quarters that price reductions would be made at a later date. Although consumers may be disappointed in so far that they will be unable to procure supplies at reduced prices, they will at least know what quotations will be up to the end of the year. Meanwhile, there is very little new business for iron and steel, and both the home and export markets are extremely quiet.

Pig-Iron

MIDDLESBROUGH.—The quietness of the foundry-iron market in this area persists, and stocks at the makers' works continue to rise, while limitations of output are being made in still more cases. There have recently been suggestions that the Government were likely to build up a reserve stock of pig-iron, but the Minister for the Co-ordination of Defence, Sir Thomas Inskip, announced in the House last week that it had been decided that they ought not to undertake the establishment of such a stock at the present time, but that the question would be kept under review. If such a stock were to be embarked upon makers would find an outlet for supplies at a time when it is very difficult to find a market. The decision of the producers to maintain prices till December 31 may have a beneficial effect, but many of the consumers are already in possession of substantial supplies. For delivery to Middlesbrough or Falkirk, No. 3 Cleveland G.M.B. foundry iron is quoted at 109s. per ton, with No. 1 foundry at 111s. 6d., and No. 4 foundry and No. 4 forge at 108s.

Hematite producers are finding it almost impossible to quote favourable prices to consumers abroad and inquiries are continually being lost to foreign competitors. The home outlet, also, is restricted and stocks are having to be accumulated. A few small parcels are changing hands, but forward business is neglected. Prices are fixed for deliveries up to the end of the year at 132s. 6d. for East Coast mixed numbers delivered on the North-East Coast, 138s. delivered Sheffield, 140s. 6d. in Manchester, and 143s. 6d. in the Midlands. The foregoing prices are subject to 5s. per ton rebate under the loyalty scheme.

LANCASHIRE.—Although there appears to have been a slight improvement in the working of light-castings establishments, this has been offset by a small contraction in operations at certain machine-tool works. So far, the decision to keep prices unchanged after June 30 does not seem to have made for any increase in buying by consumers. Business in hematite, also, remains on the quiet side.

MIDLANDS.—There is little improvement to report in this area; certain light-castings makers are slightly more active, although short time is still general in this section. It is expected that some consumers will take the opportunity to purchase additional supplies now that they are able to do this up to the end of the year, but, it must be admitted, large-scale business is very improbable while stocks are maintained at their present levels. Low-phosphoric irons are fairly well taken up, chiefly by the heavy engineering and motor trades, but activity in these sections is still rather restricted. Hematite is moderately active, but there is room for further expansion in the consumption. The Association which controls the quotation for refined iron continues to stipulate that £8 5s. shall be the minimum figure, but much lower prices are being offered by "outside" producers.

SCOTLAND.—Although it is still an economic proposition to import foreign pig-iron, little or no business is reported. Stocks of Continental iron imported before the reimposition of the duty are still quite heavy, and, in addition, substantial supplies of local iron are on hand. Thus, there are only a few small contracts being made at present. No. 1 foundry iron is quoted at 120s. 6d., with No. 3 at 118s., f.o.t. furnaces. The output of steel in this area is maintained, but the works, being well covered, are not much interested in additional supplies of pig-iron. Hematite mixed numbers are quoted, for delivery up to December 31, at 133s., Scottish basic at 107s. 6d., and English and Indian basic at 100s., all less 5s. rebate and delivered local steelworks.

Coke

Following insistent demands by the consumers, prices of Durham foundry coke have now been lowered by 5s. per ton on all sales and new contracts after June 1. Consumers have refrained from buying recently and have maintained that current quotations were too high. For delivery in Birmingham, best Durham coke is now quoted at 50s. 6d., with Welsh coke at from 50s. 6d. upwards.

Steel

Irregular conditions have ruled in the steel market, and with the approach of the summer there are indications of the usual seasonal decline in the volume of business, says the official report of the London Iron and Steel Exchange. In most departments new business is on a restricted scale, and consumers are working chiefly upon stocks and deliveries they are receiving against existing contracts. The situation in the semi-finished steel department does not improve, and most consumers have larger stocks on hand than they require. As a result the production of British semi-finished steel has been affected. It is estimated that the existing stocks will not be absorbed until towards the end of the third quarter. In the finished-steel section of the market, business continues on a restricted scale compared with the conditions ruling earlier in the year. Operations at the steelworks have declined to some extent, but production is still maintained at a high rate.

Scrap

Business in the iron and steel scrap market continues to be restricted. Any new orders are for small tonnages only and it is apparent that most consumers bought too freely when they had the need for supplies. Stocks at the merchants' depôts are steadily increasing and there are few indications that there will be any reduction in these for a considerable time to come.

Metals

There has been a slightly better tone on the metal market during the past week, but there is still a marked absence of large-scale buying.

Copper.—The copper statistics for the month of April have now been published by the American Bureau of Metal Statistics. Delay was caused by absence of information regarding the imports and stocks of Germany. World stocks of refined metal increased during the month by 1,329 short tons to 541,579 tons. World copper output declined from 161,842 tons in March to 155,007 tons in April, while the output of refined copper in April amounted to 162,588 tons, against 169,820 tons in the previous month. World apparent consumption increased from 158,700 tons to 161,261 tons. The publication of the figures had a strengthening effect on the market.

Demand on industrial account recently has shown a small improvement. The outlook in the United States remains uncertain as a result of the continued labour troubles. The weakness of scrap copper continues and the intake price has again been reduced by Customs smelters in the United States. It is now 6¾ cents per lb., which is ¼ cent below the previous level. Owing to the uncertainty of the scrap market, it is thought that the 9-cent quotation for domestic copper will be difficult to maintain.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £32 15s. to £32 17s. 6d.; Friday, £32 10s. to £32 12s. 6d.; Monday, £33 13s. 9d. to £33 15s.; Tuesday, £33 15s. to £33 17s. 6d.; Wednesday, £32 18s. 9d. to £33.

Three Months.—Thursday, £33 to £33 2s. 6d.; Friday, £32 16s. 3d. to £32 17s. 6d.; Monday, £33 18s. 9d. to £34; Tuesday, £34 to £34 2s. 6d.; Wednesday, £33 3s. 9d. to £33 5s.

Tin.—There continues to be only a meagre demand, but the tone appears to be rather better. The Colonial Office announced on Tuesday that the referendum of tin producers in the Malay States regarding the proposal for a tin buffer stock has resulted in a vote of approximately two to one in favour of the proposal. The European vote was 57 per cent. for, while the Chinese vote was 76 per cent. for. In forwarding the results of the ballot, the High Commissioner for the Malay States stressed the importance of disinterested management of the buffer stock, and has explained the views of those who have opposed the scheme. But having regard to the big majority in favour of a buffer pool, it has been decided, so far as Malaya and Nigeria are concerned, to accept the proposal in principle, subject to the negotiation of a satisfactory detailed scheme.

A meeting of the International Tin Committee is being held in Paris to-day (Thursday). The buffer pool proposals will be fully considered.

Interviewed in Amsterdam, Mr. A. F. Ruimschotel, advisory member of the International Tin Committee and manager of the sales office of the Government-owned Banka tin mines, stated that he was in favour of a tin buffer stock pool. He admitted that such a stock would lead to an increase in the world total, but said that it would have no unfavourable influence on prices. On the contrary, if the pool intervened at the right time, it would have a beneficial effect on the market.

Official quotations were as follow :—

Cash.—Thursday, £159 10s. to £160; Friday, £157 10s. to £157 15s.; Monday, £161 5s. to £161 10s.; Tuesday, £164 5s. to £164 10s.; Wednesday, £163 to £163 5s.

Three Months.—Thursday, £160 5s. to £160 10s.; Friday, £158 7s. 6d. to £158 12s. 6d.; Monday, £162 to £162 5s.; Tuesday, £164 15s. to £165; Wednesday, £163 15s. to £164.

Spelter.—This metal continues to be adversely affected by the general uncertainty of other markets. Consumers have deemed it advisable to take some advantage of the low prices, but, on the whole, the market is poorly supported.

Daily market prices :—

Ordinary.—Thursday, £12 3s. 9d.; Friday, £12; Monday, £12 7s. 6d.; Tuesday, £12 6s. 3d.; Wednesday, £11 17s. 6d.

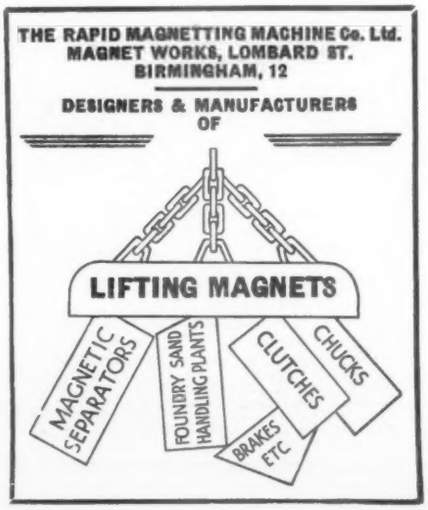
Lead.—Consumers continue to display a reserved attitude with regard to new business, as there is no incentive for them to purchase additional tonnages, supplies being plentiful. Stocks, in fact, are steadily rising. In the United States, also, the market is weak and the price has been reduced by ¼ cent to 4 cents per lb.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £13 11s. 3d.; Friday, £13 6s. 3d.; Monday, £13 13s. 9d.; Tuesday, £13 13s. 9d.; Wednesday, £13 6s. 3d.

Scrap.—Despite the fact that prices are low, further decreases have been recorded this week. Consumers are not taking much interest in the market.

Approximate selling prices for old metal:—New aluminium cuttings, £75; rolled, £58; cast, £30; foil, £88. Copper, £31 to £34; braziery, £27. Brass (clean), £20 to £23. Zinc, £7. Lead, £11. Gunmetal, £34.



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RAW MATERIALS—PRICE LIST

(Wednesday, June 1, 1938)

COPPER

	£ s. d.
Standard cash	32 18 9
Three months	33 3 9
Electrolytic	37 5 0
Tough	37 5 0
Best selected	37 15 0
Sheets	68 0 0
India	50 7 6
Wire bars	39 0 0
Ingot bars	39 0 0
H.C. Wire rods	42 10 0
Off. av. cash, May	36 14 $2\frac{5}{11}$
Do., 3 mths., May	36 19 $0\frac{9}{22}$
Do., Sttlmnt., May	36 14 $2\frac{5}{11}$
Do., Electro, May	41 5 $1\frac{5}{11}$
Do., B.S., May	40 15 10
Do., Wire bars, May	41 13 $2\frac{2}{11}$
Solid drawn tubes	11¾d.
Brazed tubes	11¾d.
Wire	7¼d.

BRASS

Solid drawn tubes	10¾d.
Brazed tubes	12¾d.
Rods, drawn	8½d.
Rods, extd. or rlld.	6d.
Sheets to 10 w.g.	7¾d.
Wire	7¾d.
Rolled metal	7¾d.
Yellow metal rods	6d.

TIN

	£ s. d.
Standard cash	163 0 0
Three months	163 15 0
English	163 0 0
Bars	165 0 0
Straits	165 0 0
Eastern	165 17 6
Banca (nom.)	—
Off. av. cash, May	162 16 $8\frac{5}{11}$
Do., 3 mths., May	163 8 9
Do., Sttlmt., May	162 16 $9\frac{5}{11}$

SPELTER

	£ s. d.
Ordinary	11 17 6
Remelted	10 5 0
Hard	10 0 0
Electro, 99·9	15 13 9
English	13 12 6
India	12 15 0
Zinc dust	17 10 0
Zinc ashes	5 0 0
Off. aver., May	12 15 $6\frac{3}{22}$
Aver., spot, May	12 13 $7\frac{7}{11}$

LEAD

	£ s. d.
Soft foreign, ppt.	13 6 3
Empire (nom.)	14 10 0
English	15 10 0
Sheets, home	21 10 0
Do. export	17 7 6
Pipes, home	21 0 0
Do. export	18 0 0
Tea lead	29 12 6
Off. aver., May	14 5 $10\frac{23}{66}$
Aver., spot, May	14 4 $2\frac{5}{11}$

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

Zinc sheets, English	26 15 0 to 27 5 0
Do., V.M. ex-whse.	26 15 0 to 27 5 0
Rods	18 10 0

ANTIMONY

English	75 0 0 to 78 0 0
Chinese, ex-whse.	56 0 0
Crude, c.i.f.	32 10 0

QUICKSILVER

Quicksilver	13 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	12 10 0
45/50%	12 0 0
75%	17 0 0
Ferro-vanadium—	
35/50%	14/- lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	4/9 lb. Mo.
Ferro-titanium—	
20/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£21 to £22
Ferro-tungsten—	
80/85%	4/8 lb.
Tungsten metal powder—	
98/99%	4/9½ lb.
Ferro-chrome—	
2/4% car.	34 15 0
4/6% car.	24 5 0
6/8% car.	24 0 0
8/10% car.	24 0 0
Ferro-chrome—	
Max. 2% car.	36 0 0
Max. 1% car.	38 5 0
Max. 0.5% car.	41 0 0
70% carbon-free	10d. lb.
Nickel—99.5/100%	£180 to £185
"F" nickel shot	£165 0 0
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese—	
76/80% loose	£18 15 0 to 19 5 0
76/80% packed	£19 15 0 to 20 5 0
76/80% export	£22 0 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated, basis 2-ton lots.

SCRAP

	£ s. d.	£ s. d.
South Wales (West)—		
Heavy steel, best	3 8	9 to 3 11 3
Mixed iron and steel	3 6	9 to 3 9 3
Heavy cast iron	3 8	9 to 3 11 3
Good machinery	3 10	0 to 3 11 3
Cleveland—		
Heavy steel, best	3 7	0 to 3 9 6
Steel turnings	2 13	0 to 2 15 6
Heavy cast iron		3 10 0
Heavy machinery		3 15 0
Midlands—		
Short heavy steel		3 12 6
Light cast-iron scrap		3 2 6
Heavy wrought iron	4 0	0 to 4 5 0
Steel turnings	2 6	3 to 2 8 9
Scotland—		
Heavy steel, best	3 5	0 to 3 7 6
Ordinary cast iron	3 13	6 to 3 15 0
Cast-iron borings	2 0	6 to 2 3 0
Wrot-iron piling	4 5	0 to 4 7 6
Heavy machinery	3 17	6 to 4 0 0

London—Merchants' buying prices, delivered yard.

Copper (clean)	27 0 0
Brass	17 0 0
Lead (less usual draft)	11 10 0
Tea lead	8 0 0
Zinc	6 10 0
New aluminium cuttings	67 0 0
Braziery copper	23 0 0
Gunmetal	28 0 0
Hollow pewter	115 0 0
Shaped black pewter	78 0 0

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 0d.
Finished bars, 18% tungsten	3s. 10d.

Per lb. d/d buyers' works.

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	111/6
,, No. 3	109/-
,, No. 4	108/-
Forge No. 4	108/-
Hematite No. 1	133/-
Hematite M/Nos.	132/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	133/-
,, d/d Birm.	144/6
Malleable iron d/d Birm.	160/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	110/-
,, No. 3 fdry.	111/-
Northants forge	107/6
,, fdry. No. 3	108/6
,, fdry. No. 1	111/6
Derbyshire forge	110/-
,, fdry. No. 3	111/-
,, fdry. No. 1	114/-
Scotland—	
Foundry, No. 1, f.o.t.	120/6
,, No. 3, f.o.t.	118/-
Cleveland No. 3, Glasgow	112/-
,, ,, Falkirk	109/-
Scottish hem. M/Nos. d/d	133/-
Sheffield (d/d district)—	
Derby forge	107/6
,, fdry. No. 3	108/6
Lincs forge	107/6
,, fdry. No. 3	108/6
W.C. hematite	138/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	114/-
Staffs fdry. No. 3	114/-
Northants fdry. No. 3	112/6
Cleveland fdry. No. 3	114/-
Glengarnock, No. 3	139/-
Clyde, No. 3	139/-
Monkland, No. 3	139/-
Eglinton, No. 3	139/-
Gartsherrie, No. 3	139/-
Shotts, No. 3	139/-

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£ s. d.	£ s. d.
Bars (cr.)	13 5 0	to 13 15 0
Nut and bolt iron	11 12 6	to 12 2 6
Hoops		14 2 6
Marked bars (Staffs) f.o.t.		15 15 0
Gas strip		14 2 6
Bolts and nuts, ¾ in. × 4 in.		17 10 0 and up
Steel—		
Plates, ship, etc.	11 8	0 to 11 10 6
Boiler plts.	11 18	0 to 12 0 6
Chequer plts.		13 0 6
Angles		11 0 6
Tees		12 0 6
Joists		11 0 6
Rounds and squares, 3 in. to 5½ in.		12 0 6
Rounds under 3 in. to ⅜ in. (untested)		12 4 0
Flats—8 in. wide and over		11 5 6
,, under 8 in. and over 5 in.		11 10 6
Rails, heavy		10 2 6
Fishplates		14 2 6
Hoops (Staffs)		12 19 0
Black sheets, 24g. (4-t. lots)		15 15 0
Galv. cor. shts. (,,)		18 10 0
Galv. flat shts. (,,)		19 0 0
Galv. fencing wire, 8g. plain		20 5 0
Billets, soft, 100-ton lots		7 17 6
Sheet bars		7 15 0
Tin bars		7 15 0

PHOSPHOR BRONZE

	Per lb. basis
Strip	10d.
Sheet to 10 w.g.	10½d.
Wire	12d.
Rods	12d.
Tubes	17½d.
Castings	15d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
to 10g.	1/5½ to 2/0½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/4½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.84
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard	102.50
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	3.15
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	40/- to 42/6
,, furnace	32/6
Durham foundry	39/6
,, furnace	32/6
Scottish foundry	40/-
,, furnace	35/- to 37/6

TINPLATES

f.o.b. British Channel ports.

I.C. cokes	20×14	per box	20/3 to 21/6
,,	28×20	,,	40/6 to 43/-
,,	20×10	,,	29/-
,,	18¾×14	,,	21/-
C.W.	20×14	,,	19/- to 20 3
,,	28×20	,,	38/- to 40/6
,,	20×10	,,	27/-
,,	18¾×14	,,	19/9 to 20/3

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£11	0	0	to £12	0	0
Bars-hammered, basis	£20	0	0	to £22	0	0
Bars and nail-rods, rolled, basis	£19	0	0	to £20	0	0
Blooms	£18	0	0	to £19	0	0
Keg steel	£30	0	0	to £35	0	0
Faggot steel	£19	0	0	to £24	0	0
Bars and rods dead soft st'l	£14	0	0	to £16	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£ s. d.	
May	26 ..	32 15 0 dec.	10/–
,,	27 ..	32 10 0 ,,	5/–
,,	30 ..	33 13 9 inc.	23/9
,,	31 ..	33 15 0 ,,	1/3
June	1 ..	32 18 9 dec.	16/3

Electrolytic Copper

		£ s. d.	
May	26 ..	37 0 0 dec.	20/–
,,	27 ..	37 0 0 No	change
,,	30 ..	37 15 0 inc.	15/–
,,	31 ..	38 0 0 ,,	5/–
June	1 ..	37 5 0 dec.	15/–

Standard Tin (cash)

		£ s. d.	
May	26 ..	159 10 0 dec.	65/–
,,	27 ..	157 10 0 ,,	40/–
,,	30 ..	161 5 0 inc.	75/–
,,	31 ..	164 5 0 ,,	60/–
June	1 ..	163 0 0 dec.	25/–

Tin (English ingots)

		£ s. d.	
May	26 ..	159 10 0 dec.	65/–
,,	27 ..	157 10 0 ,,	40/–
,,	30 ..	161 5 0 inc.	75/–
,,	31 ..	164 5 0 ,,	60/–
June	1 ..	163 0 0 dec.	25/–

Spelter (ordinary)

		£ s. d.	
May	26 ..	12 3 9 dec.	6/3
,,	27 ..	12 0 0 ,,	3/9
,,	30 ..	12 7 6 inc.	7/6
,,	31 ..	12 6 3 dec.	1/3
June	1 ..	11 17 6 ,,	8/9

Spelter (Electro, 99.9 per cent.)

		£ s. d.	
May	26 ..	16 2 6 dec.	6/3
,,	27 ..	15 17 6 ,,	5/–
,,	30 ..	16 3 9 inc.	6/3
,,	31 ..	16 2 6 dec.	1/3
June	1 ..	15 13 9 ,,	8/9

Lead (soft foreign, prompt)

		£ s. d.	
May	26 ..	13 11 3 dec.	3/9
,,	27 ..	13 6 3 ,,	5/–
,,	30 ..	13 13 9 inc.	7/6
,,	31 ..	13 13 9 No	change
June	1 ..	13 6 3 dec.	7/6

Lead (English)

		£ s. d.	
May	26 ..	15 15 0 dec.	5/–
,,	27 ..	15 10 0 ,,	5/–
,,	30 ..	15 15 0 inc.	5/–
,,	31 ..	15 15 0 No	change
June	1 ..	15 10 0 dec.	5/–

A COMPARISON OF SCRAP PRICES

Average Prices of Heavy Steel Scrap (Delivered) in the Principal Districts at the Beginning of Each Month in the Years 1931–1938.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Scotland—													
1931	2 7 6	2 7 6	2 5 0	2 5 0	2 0 0	1 17 6	1 17 6	1 17 6	1 17 6	1 15 0	2 0 0	2 10 0	2 17 3½
1932	2 2 6	2 2 6	2 0 0	1 17 6	1 17 6	1 17 6	1 15 0	1 15 0	1 12 6	1 13 0	1 12 6	2 2 6	2 1 0½
1933	1 15 0	1 17 6	1 18 6	1 18 9	1 18 0	1 17 6	1 18 9	2 0 0	2 2 6	2 5 0	2 7 6	1 15 0	1 16 9½
1934	2 8 9	2 14 3	2 13 0	2 13 0	2 12 0	2 10 0	2 10 6	2 10 6	2 11 0	2 10 9	2 10 0	2 8 9	2 0 7½
1935	2 10 0	2 10 0	2 10 0	2 10 0	2 10 0	2 10 0	2 10 0	2 10 0	2 10 0	2 10 0	2 10 0	2 10 0	2 11 2
1936	2 12 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 1
1937	2 17 6	3 2 6	3 6 0	3 5 9	3 5 9	3 5 9	3 5 9	3 5 9	3 5 9	3 5 9	3 6 3	3 6 3	3 4 9½
1938	3 6 3	3 6 3	3 6 3	3 6 3	3 6 3	—	—	—	—	—	—	—	—
North-East Coast—													
1931	2 6 0	2 6 0	2 5 0	2 5 0	2 2 6	2 0 0	1 17 6	1 17 6	1 17 6	1 17 6	1 17 6	2 2 6	2 1 2½
1932	2 0 0	2 0 0	1 15 0	1 15 0	1 15 0	1 15 0	1 15 0	1 15 0	1 15 0	1 12 6	1 15 0	1 17 6	1 15 10
1933	2 0 0	2 0 0	2 5 0	2 0 0	1 15 0	1 17 6	2 2 6	2 2 6	2 3 6	2 5 0	2 7 6	2 7 6	2 2 2
1934	2 10 0	2 16 0	2 10 0	2 7 6	2 7 6	2 10 0	2 9 9	2 10 0	2 10 0	2 10 0	2 11 6	2 11 3	2 10 3½
1935	2 11 6	2 11 9	2 12 0	2 12 0	2 12 6	2 12 6	2 12 6	2 12 6	2 12 6	2 12 6	2 12 6	2 13 9	2 12 4½
1936	2 15 0	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	3 0 0	3 0 0	2 17 8½
1937	3 2 6	3 5 0	3 7 0	3 7 9	3 7 9	3 7 9	3 7 9	3 7 9	3 7 9	3 7 9	3 8 3	3 8 3	3 7 1½
1938	3 8 3	3 8 3	3 8 3	3 8 3	3 8 3	—	—	—	—	—	—	—	—
South Wales—													
1931	2 5 0	2 7 6	2 7 6	2 7 6	2 5 0	2 2 6	2 0 0	2 0 0	1 18 0	2 2 6	2 5 0	2 7 6	2 4 0
1932	2 6 6	2 6 0	2 5 0	2 2 6	2 2 0	1 19 0	1 17 6	1 18 6	1 18 0	1 18 0	1 17 6	1 18 0	2 0 8½
1933	2 0 0	2 1 6	2 4 0	2 3 6	2 3 6	2 3 0	2 5 0	2 5 0	2 8 0	2 10 0	2 10 0	2 10 0	2 5 3½
1934	2 10 0	2 16 3	2 15 9	2 13 9	2 14 3	2 15 0	2 14 3	2 14 3	2 15 0	2 15 6	2 15 6	2 15 6	2 14 7
1935	2 15 6	2 15 6	2 15 6	2 15 6	2 15 6	2 15 6	2 15 6	2 15 6	2 16 1½	2 17 9	2 19 8	3 1 1½	2 16 2½
1936	3 2 6	3 5 0	3 5 0	3 5 0	3 5 0	3 5 0	3 3 0	3 2 0	3 2 0	3 4 0	3 4 0	3 4 0	3 3 10½
1937	3 5 0	3 10 0	3 10 0	3 8 9	3 8 9	3 8 9	3 8 9	3 8 9	3 8 9	3 9 9	3 9 9	3 9 9	3 14 7½
1938	3 10 0	3 10 0	3 10 0	3 10 0	3 10 0	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG

IRON

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

SITUATIONS VACANT AND WANTED

FOUNDRY MANAGER desires change. Modern methods, good organiser, vast experience. Machine tool, high-duty or repetition production; economy; efficiency. First-class refs. Age 40. I.B.F. man.—Box 956, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EXECUTIVE position in iron or steel industry sought by qualified Accountant (27). Sound knowledge foundry practice, management. Secretary of iron and steel foundry (capital £500,000); seeks more progressive post. First-class references.—Box 936, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATTERNMAKER wants job. Age 23. Experienced in oil and gas engines, agricultural. Any district. Further particulars willingly.—T. O. SPRINGFIELD, 23, Harrow Street, Grantham.

ASSISTANT FOREMAN required for non-ferrous foundry in Midlands. Progressive post for competent and active man aged about 30. Write giving particulars of experience and salary required to: Box 960, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY SUPERINTENDENT wanted for grey-iron foundry in Black Country District. Must be used to modern machine-moulding methods and capable of progressing new work into production. Permanent position for the right man. Applicants should reply, stating age, salary required, and experience. All correspondence treated confidentially.—Box 944, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY SUPERVISOR wanted, Black Country area. Experienced in the production of R.W. and Soil Pipes, must be capable of handling trained moulders, and prepared to undertake the training of any labour. Permanent position and good prospects for the right man. Apply stating age, salary, and full particulars of past employment. All correspondence treated in confidence.—Box 962, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

KENT EDUCATION COMMITTEE.

MEDWAY TECHNICAL COLLEGE.

APPLICATIONS are invited for the position of full-time Teacher of Metallurgy. Candidates must be graduates in Metallurgy, including non-ferrous metals. Industrial experience in this branch of work is also particularly desirable.

Duties will include the teaching of Metallurgy in day and evening classes to engineering students in National and Higher National Certificate Courses, and will further include the teaching of Analytical Chemistry to the standard of subsidiary final B.Sc.

Forms of application can be obtained from the District Education Officer, Fort Pitt House, New Road, Rochester, and should be forwarded, when completed, to the Head of Senior Departments, Medway Technical College, Gillingham, Kent, not later than June 30.

P. R. MORRIS,
Director of Education.

SALES AND COSTS MANAGER wanted by ironfounders making small and medium high-class grey-iron castings, to control sales and costing organisation. Experience essential and preferential. Consideration given to applicant who can introduce business. State age, experience, and terms to: Box 948, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

STEEL FOUNDRY MANAGER required, capable of taking full control of production of carbon and alloy repetition castings, and also large castings up to 14 tons weight, from electric furnaces. Only men of proved ability need apply. Write, giving full particulars, age, and salary required, in strict confidence, to: GENERAL MANAGER, DAVY AND UNITED ROLL FOUNDRY, LIMITED, Billingham, Co. Durham.

SITUATIONS VACANT AND WANTED—*Contd.*

REQUIRED for early July, 25/30 years' applicant for sales office handling travellers selling all raw materials to foundry and steel trade. Experience of sales office essential. Energetic, initiative and modern outlook. State salary and full experience.—Box 958, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

METALLURGIST wanted, possessing first-class qualifications and experience in modern furnace practice. Apply by letter only, stating age and salary required to: SHELL-MEX & B.P., LTD., Fuel Oil Department, Shell-Mex House, London, W.C.2.

SALES MANAGER required for important Midland firm of Vitreous Enamellers. Qualifications are:—Good knowledge of the Vitreous Enamelling Industry, sales ability, and preferably existing connection among those requiring vitreous-enamelled products.—Box 964, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

AGENCIES

AGENTS, with first-class connections, required by Midland Foundry manufacturing high-class repetition grey-iron castings. Full particulars to: Box 952, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ACTIVE AGENT with first-class connection, constantly covering London and 50 miles radius, seeks additional line, preferably Small Repetition Grey Iron or Brass Castings. Results absolutely guaranteed. Only well-established firms able to cope with substantial quantities entertained.—Box 856, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATENT

THE Proprietor of the Patents Nos. 409,251, 408,234 and 414,617, for Improvements in Clutches and Change-Speed Mechanisms, is desirous of entering into arrangements by way of licence and otherwise, on reasonable terms, for the purpose of exploiting the same and ensuring their full development and practical working in this country. All communications should be addressed in the first instance to: HASELTINE LAKE & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

MACHINERY

'Phone **98** Staines.

SCREWING MACHINE, up to 6-in. pipe, by Louden.
2½-ton Overhead Hand Crane, 22-ft. span.
Ingersoll Rand Compressor, Type 14.
Air Receiver, 6 ft. 6 in. by 2 ft. 6 in., 100 lbs.

HARRY H. GARDAM & CO., LTD.,
STAINES.

SANDBLAST PLANTS.

ROOMS size, 12 ft. by 12 ft., 12 ft. by 9 ft., and 6 ft. by 6 ft.
Barrels: 54 in. by 36 in.; 36 in. by 30 in.; 30 in. by 20 in., etc.
Cabinet: 6 ft. by 4 ft.; 4 ft. 6 in. sq. by 3 ft. 6 in. sq., and 30 in. dia.
Table: 9-ft. Guttman.
Air Compressors in stock to suit any of the above plants.
Sand Mills: 7 ft. 6 in., 7 ft., 6 ft., 5 ft. and 4 ft. dia. pans.
Cupolettes: 10 cwts., 15 cwts. and 20 cwts.
Cupolas: 2 and 3 tons.
Morgan Tilting Furnaces: 250 and 400 lbs.
Heavy D.E. Grinding Machine: wheels 24 in. by 4½ in.
Sand Rammers, Disintegrators and Mixers. Air Compressors, Blowers and Exhaust Fans, Moulding Machines, etc., etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.,
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

MACHINERY—*Continued*

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